THE
BUILDER's Cheſt-Book;
Or, A Complete
KEY
TO THE
FIVE ORDERS
IN
ARCHITECTURE.

Wherein, by Way of Dialogue, the Etymology, Characters, Proportions, Profiles, Ornaments, Meaſures and Diſpoſitions of the Members of their ſeveral Columns and Entablature are diſtinctly conſider'd and explain'd with reſpect to the Practice of *Palladio*.

TOGETHER

With the Manner of drawing the Geometrical Elevation of the Five Orders of Columns, and to meaſure the ſeveral Parts of Buildings in general.

By B. LANGLEY.

The SECOND EDITION, much Improv'd.

To which is added,

Geometrical RULES made eaſy for the Uſe of Mechanicks concern'd in Buildings: Containing, New and Infallible Methods, for Striking out from proper Centers, the Groyns of Arches regular and irregular, the Angle Brackets of Coves, Crowns of Beaufets circular or elliptick. With many other uſeful Problems relating to all Curve Lines introduc'd in Building Alſo, An Eſſay, on the Nature and Properties of Arches in general, mechanically conſider'd; exemplified by ſeveral Geometrical Figures, demonſtrating their Properties and Powers. With ſome Remarks on the intended Bridge at *Weſtminſter*.

The Whole deſign'd chiefly for the Information and Uſe of all Gentlemen, Builders, Artificers, &c.

By ISAAC GADSDON.

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The Second Edition, Carefully reviſed, and re-examined from the Preſs, with the Addition of a New Frontiſpiece, repreſenting the intended Front of the New Manſion-Houſe, for the Lord Mayors of the City of London; *and a Compleat Table of Contents, alphabetically digeſted.*

THE Gentleman's and Builder's Repoſitory; or, Architecture Diſplay'd. Containing the moſt Uſeful and Requiſite Problems in Geometry. As alſo, The moſt eaſy, expeditious and correct Methods for attaining the Knowledge of the Five Orders of Architecture, by equal Parts and fewer Diviſions, than any Thing hitherto publiſhed. Together, with all ſuch Rules for Arches, Doors, Windows, Cieling-pieces, Chimney-pieces, and their particular Embelliſhments as can be required. Likewiſe, A large Variety of Deſigns for Truſs Roofs; with the Method of finding the Hip, either Square or Bevel. Alſo, the moſt certain and approved Methods of forming a Number of different Stair-Caſes, with their Twiſted Rails, *&c.* The Whole embelliſh'd, not only with eighty-four Plates, in Quarto, but ſuch Variety of Ceiling Pieces, Shields, Compartments, and other curious and uncommon Decorations as muſt needs render it acceptable to all Gentlemen, Artificers, and others, who delight in, or practiſe, the Art of Building. The Deſigns regulated and drawn by E. Hoppus, Surveyor, and engraved by B. Cole.

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B M

To the Worſhipful

The Maſters, Wardens, *and* Courts of Aſſiſtants, *in the* Carpenters, Bricklayers, Joyners, Plaiſterers, *and* other Companies, *now ſubſiſting in the City of* London, *whoſe reſpective Occupations have the leaſt Tendency to the Study and Practice of the* Art of Building.

GENTLEMEN,

AS the Inſtruction of Youth, in any Art or Science, is a Concern of the laſt Importance, and their future Happineſs, or Misfortune, in a great Meaſure depends on the firſt Impreſſions which are made on their tender Minds, and the firſt Principles laid down for the Regulation of their Conduct in that Station of Life to which Providence has more peculiarly aſſign'd them: And as it is your particular Province to contribute all you can towards the future Improvements and Succeſs of ſuch Young Perſons as are deſirous of being admitted Members of Your reſpective Companies, I humbly hope the Freedom I have taken to ſhelter the following *Familiar Dialogues*, which contain the Rudiments of Architecture, *&c.* under Your Patronage and Protection will need no Apology or Excuſe.

THE true Intent of this Addreſs, is, Knowing You to be Judges of the Subjects treated on, earneſtly to perſwade You to put this Treatiſe into the Hands of ſuch Lads for the future, as ſhall be bound Apprentices at Your reſpective Halls, and ſeriouſly to recommend the Study thereof; by which in a few Years we are perſwaded the Knowledge of this Noble Science will be much better underſtood, by the common Workmen of Your ſeveral Trades, amongſt whom we have ſo often obſerv'd ſuch Ignorance that mov'd my Compaſſion to make this Attempt, and if it ſhould have its deſir'd Effect, the Purpoſe will be anſwered to

GENTLEMEN,

Your Moſt Humble Servants,

The EDITORS.

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THE
PREFACE
TO THE
READER.

THE following Diſcourſe by way of Dialogue, on the Proportions of the Five Orders of Columns in Architecture, being written for the Uſe of young Students, as well as for the Eaſe of thoſe who are ſomething advanced therein; I have therefore made Choice of thoſe beautiful Proportions as were practis'd by that grand Architect *Palladio*.

The Meaſure by which I proportion their ſeveral Parts, is the Diameter of the

Column at its Baſe, divided into ſixty equal Parts, each of which I call a Minute.

The Method of ſetting of the Projecture of the Parts of an Order from its upright, as practiſed by *Palladio*, I do not follow; it being more difficult to the young Student, than to ſet them from the Central Line of the Column, including the Semi-diameter thereof.

The Diameter of a Column divided, as aforeſaid, I call a Module, and uſe it as ſuch throughout the Five Orders in general.

The following Diſcourſe conſiſts of nine Dialogues of Architecture, wherein are very conciſely and familiarly exhibited, the ſeveral Parts of a Building. The Etymology, Characters, Proportions, Ornaments and Diſpoſitions of the ſeveral Orders.

The ſeveral Parts relating to Materials and Buildings in general, are digeſted into ſuch a manner, as they ought to be read by every Student herein.

And although this ſmall Tract does not comprehend all the moſt uſeful Parts of Architecture, as perhaps it might have been expected to have done. Yet there is not any one thing omitted, as is neceſſary to a young Student at his firſt ſetting out.

As to the other more important Parts, I ſhall communicate them, when my young Student is well acquainted with theſe Rudiments, or firſt and moſt neceſſary Principles of Architecture, which ought to be often read and practiſed before he proceeds any further. For indeed the chief Motives of compiling this ſmall Diſcourſe were; for the Improvement of Youth, who at preſent if ſtrictly obſerved, are for the greateſt Part very ignorant of true Proportions, that are the Fundamentals and very Life of Architecture.

And that what I aſſert, may not appear as an Untruth, let any one as have Judgment herein, but obſerve the many prepoſterous Structures carrying on, and executed every Day, and very often at a much greater Expence to the Builder or Maſter, than if they had been truly perform'd, according to the beautiful Proportions of Architecture. 'Tis very obſervable, that moſt of our young Men of the building Trade, have more occaſion to be bound Apprentice when they have before ſerved Seven Years, and are out of their Time, than when they were firſt put Apprentice, the ſeven Years before. For 'tis very rarely ſeen, that few or any of them know more than Jobbing Work, and have heard of *Palladio, Scamozzi*, &c. but know nothing of their Orders.

This very great Ignorance among Workmen, is a great Prejudice to every one as employs them, as well as a great Shame either to them or their Maſters to whom they were bound.

And as there is nothing ſo commendable in Youth, as being ingenious and good Workmen, and nothing ſo deſpiſeable as Blockheads and bad Workmen; 'tis therefore that I endeavour to explain the Beauties of Architecture, which will enable them to be of much greater Service to themſelves and Families, as well as the Commonwealrh in general.

In the putting young Men to Maſters, there ought to be a very great Regard had to their Abilities, for when an ingenious Boy is bound to a Man, who has the good Fortune to have great Plenty of indifferent common Buſineſs, his Taſte and Genius to the Trade is often ruin'd.

Therefore I adviſe that all Parents have a very great Regard to the Character and Knowledge of the Maſters, to whom they bind their Children; and that they do alſo Covenant, that they be carefully and truly taught the Proportions and Manner of working the Five Orders of Columns in Architecture, applied to Practice in all ſuch Parts of a Building as their Trades doth belong to.

And although this Advice will be rejected by ſome; yet for the general part, and eſpecially the Wiſe to whom I write, will commend and practiſe it, who in the End will find very great Advantages thereby.

To conſider of the many Treatiſes o Architecture as have been written by *Vitruvius*, *Palladio*, *Scamozzi*, *Serlio*, *Vignola*, and many other ſamous Architects would ſeem, that what follows them, would be needleſs: But notwithſtanding that may be a general Opinion, yet 'tis very plain that their Rules and Proportions being here explain'd in a manner more intelligible than that by them exhibited, 'twill prove a very great Help to the young Student, and ripen his Underſtanding therein much ſooner than when he reads their Rules, that are laid down after a very intricate (inſtead of an eaſy) Manner.

B. LANGLEY.

A

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A
Compleat KEY
TO THE
FIVE ORDERS
OF
ARCHITECTURE.

M. *WHAT is an Architect?*

P. A Perſon Skilful in the Art of Building.

M. How many principal Parts is Architecture divided into?

P. Three. Civil, Naval, and Military.

M. *What is Civil Architecture?*

P. The Art of Building dwelling Houſes, commodious Habitations, Publick Edifices, *&c.*

M. *What is Naval Architecture?*

P. The Art of Building Ships and other Veſſels for War, Commerce, *&c.*

M. *What is Military Architecture?*

P. The Art of Building Fortifications, or Buildings of Defence.

M. *How many Conditions doth well Building conſiſt of?*

P. Three. Convenience, Strength and Beauty.

M. *What are the moſt Commodious Geometrical Figures for Plans of Buildings?*

P. The Geometrical Square and Parallellogram.

M. *Is not the Triangle, Pentagon, Hexagon, &c. as proper Figures for Plans as the Preceding?*

P. No. Except for Military Buildings, where the Baſtions are laid out at the Angles, and the Sides ſerve for Curtains.

M. *Why is the Triangle, Pentagon, Hexagon, &c. improper Plans for Civil Architecture?*

P. For two Reaſons. Firſt, Becauſe that right Angle is the ſtrongeſt Angle as can

be

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be made, of which the Triangle, Pentagon, &c. hath not any. But are either Acute or Obtuſe angled, and therefore much weaker in their Bondage.

Secondly, On Account of the ſeveral Inconveniences which attend thoſe Forms, in Reſpect to Light, irregular Rooms, Vacuities, &c.

M. Is therefore the ſeveral Polygons to be wholly excluded in Civil Architecture?

P. No. (and in particular the Octagon) When applied to ſingle Rooms for Banqueting, &c. Such as that Octagon Room of the Honourable *James Johnſon* at his Seat in *Twickenham*. Thoſe Polygons then are very Beautiful and Grand.

M. What is the Reaſon why the Circle is not made uſe of in private Buildings.

P. Becauſe the circular Buildings are moſt chargeable, and much Room is loſt by the Curvature of the Walls.

M. In what Kind of Buildings is the Circle to be uſed?

P. In Cathedrals, Temples, Amphitheatres, &c.

M. Which of the preceding Geometrical Figures is the moſt commodious for private Buildings?

P. The Paralellogram.

M. What Proportion is beſt for ſuch a Parallellogram?

P. That the Depth conſiſt of two Thirds of its Length, and thereby the Aſpect will be Grand and not diminiſhed.

M. Under how many Heads may all the Parts of every Fabrick be comprized?

P. Five as Following. The Foundation, the Walls, the Appertions or Openings, the Compartitions and the Roof and Cover.

M. What Method is to be taken in the Foundations of Buildings?

P. That they are perfectly Sound and truly Level.

M. What Thickneſs is neceſſary for the Foundation of Buildings in general?

P. At leaſt double to the Dependant Wall.

M. How many Kinds of Walls are in a Building?

P. Two. The one entire and continual, the other intermitted.

M. What are the Intermiſſions?

P. Columns, Pillaſters or Both.

M. What is moſt neceſſary to be obſerved in the Building of Walls?

P. That the Materials be good, that the moſt Heavy be laid at Bottom, that they diminiſh in Thickneſs proportionable to their Height, that they be exactly Perpendicular, and that the Angles be firmly bound.

M. You was before ſaying that the Intermiſſions of Walls are Columns or Pillaſters; What is a Column?

P. A Column is a round Pillar (compoſed of three Parts, viz. its Baſe, Shaft and Capital) uſed in Buildings for the Support of Entablatures, according to its reſpective Order.

M. What is an Entablature?

P. An Ornament (ſaith *Vitruvius* & *Vignola*) conſiſting of the Architrave, Freeze and Cornice of any Order.

M. What is a Pillaſter?

P. A Pillaſter is a ſquare Pillar, having its Baſe and Capital as the Column in every reſpect, but doth not diminiſh upwards as a Column doth, except it be plac'd with Columns, and is different in all the Orders.

M. How many Orders are in Civil Architecture?

P. Five. Of which three are Greek and two Latin.

M. What are the Greek Orders?

P. The Dorick, Ionick and Corinthian.

M. What are the Latin Orders?

P. The Tuſcan and the Compoſite.

M. Is not there more Orders than the preceding Five?

P. Yes. The Attick, the Perſian and the Caryatides.

M. What is the Attick Order?

P. An Order conſiſting of Pillaſters with a Cornice Architrived only for its Entablature.

M. What is the Perſian Order?

P. The Perſian Order is that which hath Slaves placed to ſupport the Entablature inſtead of Columns.

M. What is the Caryatic Order?

P. The ſame as the preceding, excepting that Women are placed, as aforeſaid, inſtead of Men.

M. In what Parts of a Building are Pillaſters uſed?

P. To ſupport the Entablatures as before is ſaid of Columns, ſtanding ſometimes free and detached from the Wall. But moſt commonly contiguous to it, or within it, ſo as not to ſhew more than one fourth or fifth Part of its Side.

M. What are the principal Parts of an entire Order?

P. The Pedeſtal, Column and Entablature.

M. What are the Parts of a Pedeſtal?

P. The Baſe, the Die or Trunck, and the Cornice.

M. What are the Parts of a Column?

P. The Baſe, Shaft, and Capital.

M. What are the Parts of an Entablature?

P. The Architrave, Freeze and Cornice.

Of the TUSCAN *Order.*

M. WHY *is the Tuſcan Order ſo called?*

P. Becauſe that the Aſiatick Indians, who are ſaid to have firſt peopl'd *Italy*, brought it into that Part call'd *Tuſcany*, whence the Name derived.

M. What is the principal Character of the Tuſcan Order?

P. Simplicity, in reſpect to its Plainneſs.

M. In what Buildings is this Order to be uſed?

P. Where Strength and Solidity is required, as Amphitheatres, Gates, Magazines, Priſons, Bridges, &c. and for illuſtrious and majeſtic Decorations, as the *Trojans* and *Antoninus* Columns at *Rome*, and that of *Theodoſius* at *Conſtantinople*.

Tuscan Order.

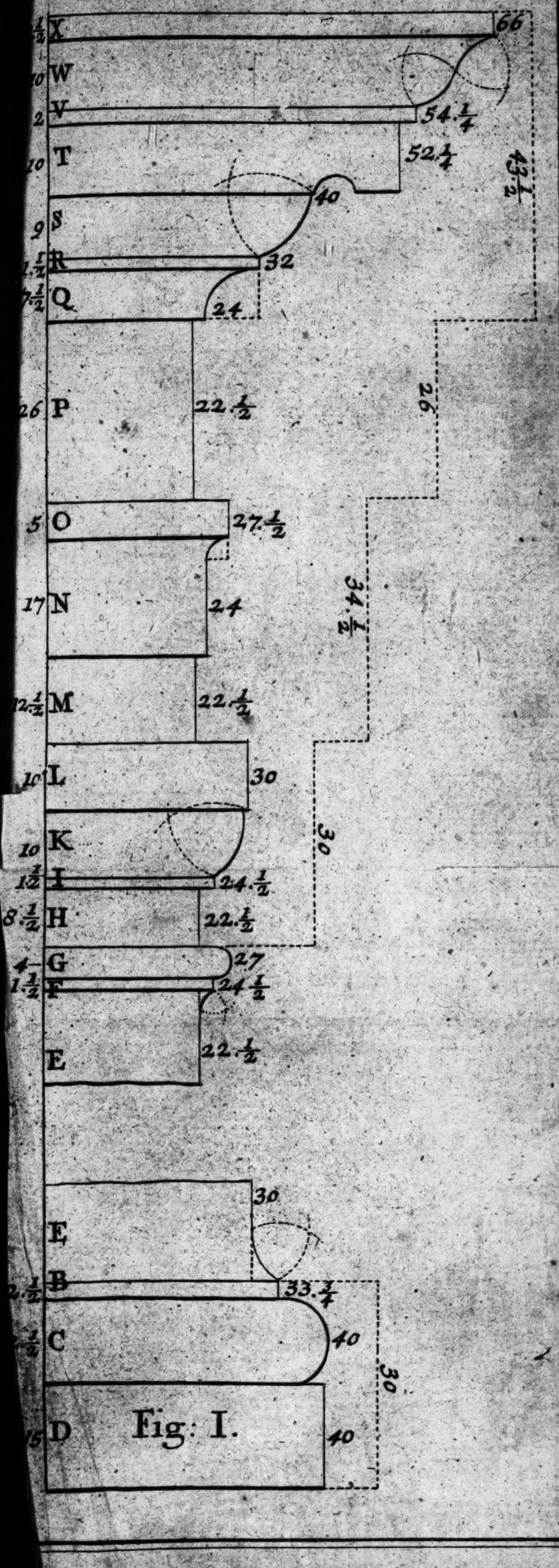

Fig: I.

M. *In the preceding Lecture you demonſtrated to me that every Order is compoſed of three principal Parts, and every of thoſe Parts, of three others, &c. And I finding that every of thoſe reſpective Parts are compos'd of divers Members, I deſire that you demonſtrate the Number and Name of every Member reſpectively?*

P. I will. And in order thereto, ſhall, throughout the whole Demonſtrations, make uſe of the ſeveral Orders, as laid down by *Palladio*.

M. *How many Parts are in the Tuſcan Pedeſtal?*

P. One only, viz. the Zoccolo, or Die.

M. *How came it to paſs that Palladio did not give a Baſe and Capital to his Tuſcan Pedeſtal?*

P. That thereby it might be the moſt plain and ſolid.

M. *How many Parts are in the Baſe of the Tuſcan Column?*

P. Three, viz. the Cincture B, the Torus C, and the Plinth D.

M. *Is the Cincture of the Baſe of all or any of the other Orders included in the Baſe?*

P. No, never but in the Tuſcan Order.

M. *What are the Parts of the Tuſcan Column?*

P. The Shaft E, and Capital I, K, L.

M. *How many Parts are in the Shaft?*

P. Two, viz. the Body E, and the Aſtragal F G.

M. *How many Parts are in the Capital?*

P. Four, viz. the Abacus L, the Ovolo or Echinus K, the Annulet I, and the Hypotrachelium or Freeze H.

M. *What are the Parts of the Entablature?*

P. The Architrave, Freeze and Cornice.

M. *How many Parts or Members are in the Architrave?*

P. Three, viz. M, N, two Facia's, and the Fillet O.

M. *How many Parts or Members are in the Cornice?*

P. Seven, viz. the Liſt or Fillet X, the Cima Recta W, the Regula V, the Corona T, the Ovolo S, the Fillet R, and the Cavetto Q.

M. *I obſerve that every Member has its particular Name, pray demonſtrate the true Expoſition of each?*

P. I will, and in order thereto, will begin at the Pedeſtal, and proceed upwards, demonſtrating every Member in its Place.

1. (The) ZOCCOLO, A (from the Italian) a ſquare Body placed for the Support of Statues, Vaſes, &c.

2. (D the) PLINTH from the Greek *Plinthos*, a ſquare Brick or Table placed under the Mouldings of the Baſe of a Column, Pedeſtal, &c.

3. (C the) TORUS from the Greek *Toros*, a Cable which its Swelling ſomething reſembles, or rather from the Latin *Torus*, a Bed.

4. (B the) CINCTURE, a Fillet or Liſt at the Bottom of the Column, from the Italian *Liſtello*, a Girdle.

5. (E the) SHAFT or *Fuſt*, from the Latin *Fuſtis* a Club, which *Vitruvius* called *Scapus*, is that Part which is comprehended between the Cincture B, and Fillet F.

6. (G the) ASTRAGAL from the Greek, *Aſtragalos*, the Bone of the Heel, 'tis that round Moulding or Coller as encompaſſes the upper Part of the Shaft. The Italians call it *Tondino*, being like a Torus.

7. (H the) HYPOTRACHELIUM, from the Greek, denoting the Neck of the

Column, 'tis a Kind of a Freeze to the Capital, and by ſome called the Collar.

8. (I the) ANNULET or Ring placed under K, the *Ovolo* or *Echinus*, a Greek Word ſignifying the Shell of a Cheſnut, call'd by moſt Workmen *quarter round*, 'tis oftentimes enriched with a carved Ornament, of Eggs or Hearts, with Darts between, ſymbolizing Love, &c. as in the Capital of the Trajans Column at Rome.

9. (L the) ABACUS, from the Greek Word *Abax*, ſignifying in Architecture that ſquare Piece, which crowns the Capitals of Columns as L.

10. M and N, FACIA's or *Faſcia*'s, or as ſome call it *Faſce*'s from the Latin Word *Faſcia*, a large Turban. 'Tis the Band of an Architrave, &c. which when divided into two Facia's, as herein, the lowermoſt muſt ever be the narroweſt, and the uppermoſt to finiſh with a Cymatium inverted, or a Fillet as O.

11. (P the) FREEZE, from the Latin *Phrygio*, an Embroiderer, or from the Italian *Freggio*, a fring'd or embroider'd Belt. 'Tis

that Member as ſeparates the Architrave from the Cornice, which in all the Orders, the *Tuſcan* excepted, is commonly adorn'd with divers Enrichments, as the *Dorick* with its Triglyphs. The *Ionick* with its Feſtoons, &c. Sometimes the Freeze is called *Zophorus*, from the Greek *Zoophoros*, it being uſually enriched with the Repreſentations of Animals.

12. (Q the) CAVETTO, from the Latin *Cavus*, a Hollow, being the 4th of a Circle.

13. The LIST or *Fillet* R, and *Ovolo* S, are already explained in the 8th Article hereof.

14. (T the) CORONA by ſome called *Supercilium*, or rather *Stillicidium* the Drip. 'Tis a conſiderable Member being not only as'twere a Crown to the Whole, but defends all the reſt of the Edifice from Rain, bad Weather, &c. and therefore has its Projecture proportionably. The inward and outward Curvature of an Arch, Vault, &c. is alſo called Corona. The under Part of Corona's are called *Planceres*, and by the Italians, *Soffito*, generally enriched with *Mo-*

dillions, and between them *Roſes*, *Pomgranates*, *Fretts*, &c.

15. (V the) REGULA called alſo *Liſtello*, *Cincta*, &c. is a Member which ſeparates the *Corona* and *Cima Recta* W.

16. (W the) CIMA RECTA, or *Cymaiſe*, from the Greek *Kymation* a wave, called by Engliſh Workmen *Ogee*, which is of two Kinds, viz. *Cima Recta*, called by Workmen the *fore Ogee*, as W, and *Cima Reverſe*, or the *Back Ogee*, whoſe Beauty conſiſts in having its Height and Projecture equal to each other.

M. Theſe Parts thus explain'd I well underſtand: I now deſire that you, in the like manner, explicate the principal Parts of a Column, as the Pedeſtal, Column and Entablature.

P. Firſt, (ſee *p.* 7.) a Pedeſtal is compoſed of three Parts, viz. its *Baſe*, *Die* or *Trunk*, and the *Cornice*; 'tis a ſquare Body ſerving as a Foot for the Column to ſtand upon, whoſe Height, according to *Vignola*, is one third Part of the Height of its Column. Pedeſtals differ in different Orders and are ſometimes called *Stercobate* or *Stylo atae*, from the Greek *Stylobates*, the Baſe of a Column.

Secondly, COLUMN, from the Latin *Columna* a Support, is divided into its *Baſe*, *Shaft* and *Capital* (as is ſaid before) the Baſe of a Column (from the Greek *Baſis*, a Reſt or Support) is that Part as bears up the Shaft, as D C B taken together. The *Capital* of a Column is the upper Part thereof, from the Latin *Caput*, the Head or Top; and is that Part on which the Architrave is placed, as G, H, I, K, L, Fig. II. Such Capitals as have no Ornaments, as the *Tuſcan* and *Dorick*, are called *Capitals with Mouldings*; and the other as the *Ionick*, *Corinthian*, and *Compoſite*; *Capitals with Sculptures*.

Laſtly, ENTABLATURE from the Latin *Tabulatum* a Ceiling. For originally the *Freeze* was formed by the Ends of the Joiſt, as reſted upon the Architrave, which is the principal Beam and firſt Member of the Entablature, as bears upon the Capital of the Column, as M, N, O. Fig. I. and M, N, of Fig. II. &c. The Word is from the Greek, *Archos*, *Chief*, and Latin, *Trabs*, a Beam. By ſome Architects 'tis called *Epiſtyle* (Greek) *Epi*, upon, and *Stylos* a

Column-

Column. The Freeze is already explained, and therefore ſhall proceed to the Cornice (from the Latin, *Coronis*, a Crowning) the third and uppermoſt Part of the Entablature, as Q, R, S, T, V, and W. Fig. I.

M. By what Meaſure is the Parts of a Column meaſured?

P. The Diameter of the Column at its Baſe divided into 60 equal Parts, called *Minutes*, and the whole Diameter, ſo divided, is called a *Module*.

M. How many Modules in Height is contained in the Tuſcan Column and its Entablature?

P. The Height of the *Tuſcan Column* excluſive of its *Baſe and Capital*, is ſix Modules, and with them ſeven, each being equal to half a Module, and the *Height of the Entablature*, is equal to one fourth of the *Column* including the *Baſe* and *Capital*.

M. What Diminution hath the Shaft of the Tuſcan Column?

P. Fifteen Minutes, or one fourth Part of its Diameter at the Baſe.

M. Is the Tuſcan Column ever fluted as others are?

P. No. Its Plainneſs ſtrictly forbids it.

M. What is the INTERCOLUMNATION of Columns?

P. INTERCOLUMNATION, from Latin *Intercolumnium*, is the Diſtance between two *Columns*, which in the *Dorick* Order is regulated according to the Nature of its Ornaments in the *Freeze*; but in the *Tuſcan*, *Ionick*, *Corinthian* and *Compoſite* Orders, the *Intercolumnation* is of five different Kinds, as

Firſt, ARÆOSTYLE, from the Greek *Aracos*, rare, and *Stylos*, a Column; by which *Vitruvius* ſignified the greateſt Diſtance which can be made between the *Columns*, conſiſting of four *Modules* or Diameters of the *Column*, belonging to the *Tuſcan* Order, to be practiſed at the Entrance of *Cities*, *Forts*, &c.

Secondly, DIASTYLOS, from the Greek *Dia*, between, and *Stylos*, *Column*, an *Intercolumnation* of three Diameters, moſt natural to the *Dorick*, and of four to the *Ionick*, to be uſed for Gates, Galleries, Porches, Frontiſpieces, &c.

Thirdly, SYSTYLOS, called *Pienoſtyle*, thick of Pillars, an *Intercolumnation*, as doth not exceed one Diameter and half, belonging chiefly to the *Compoſite*, to be uſed before Temples and other magnificent Works.

Fourthly, EUSTYLOS, from the Greek *Eus*, well, and *Stylos*, a *Column*, an *Intercolumnation* of two Diameters or very little more, proper for the *Ionick* and *Corinthian*, being of all other the moſt graceful. *Vitruvius* allowed this *Intercolumniation* two Diameters and a Quarter, maintaining it to be the beſt Manner of placing *Columns* with Regard to their Diſtance.

pl

Dorick Order.

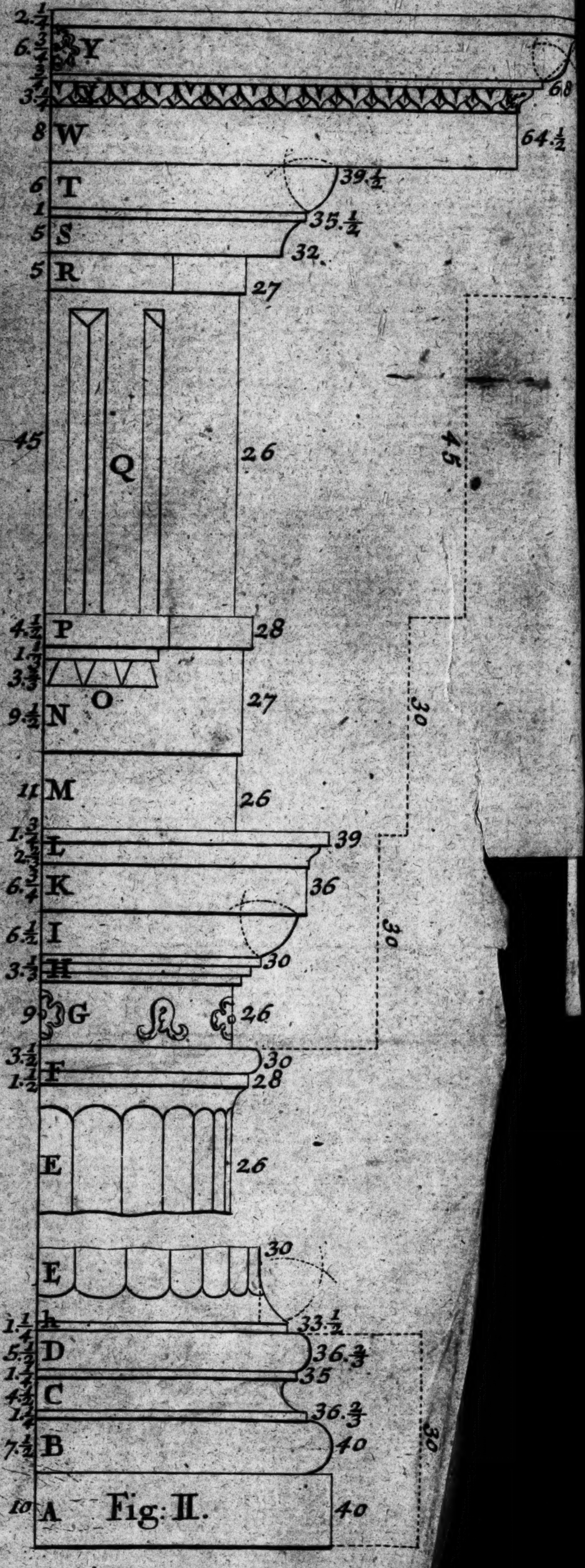

Fig: II.

Of the DORICK *Order.*

M. W*HY is the Dorick Order ſo called?*

P. Becauſe that *Dorus*, King of *Achaſis*, built a a magnificent Temple to the Goddeſs *Juno*, in the City of *Argos*, which, *Vitruvius* ſaith, was the firſt Model of this Order.

M. What is the principal Character of this Order?

P. Solidity and Beauty.

M. In what Buildings is this Order to be uſed?

P. Where Strength and Grandeur is required as in Ports of Citadels, Outſide of Temples, Churches, Theatres, Triumphant Arches, &c.

M. Is there not a particular Method to be obſerved in this and all other Orders, to make them appear grand and noble?

P. Yes. By obſerving that the Diviſion of the principal Parts of the Order, conſiſt but of few Members, and thereby they will be grand and of a noble Aſpect.

M. Why hath few and large Mouldings a better Aſpect or Effect in Maſſy Buildings, than when they are many and ſmall?

P. Becauſe that ſmall Ornaments do divide and ſcatter the Angles of Sight in ſo many Rays preſſed together, that the whole appears but a Confuſion.

M. What were the ancient principal Parts of this Order?

P. Two only, viz. the *Column* and *Entablature.*

M. Had not this Order anciently a Pedeſtal as now it hath?

P. No. Nor even a *Baſe* to the *Shaft* of its *Column,* for in the faireſt Works of Antiquity, as the Theatre of *Marcellus* at *Rome,* that at *Vicenza,* and many others in which this Order has been employed, 'twas found without *Baſes.*

M. What do you ſuppoſe to be the Reaſon that the Ancients did not allow a Baſe to the Dorick Order?

P. Becauſe that its Aſpect is robuſt and ſtrong, like unto that of *Hercules*, who is always repreſented on his bare Feet.

M. And therefore muſt this Order be always uſed without a Baſe?

P. No. For the modern Architects have given it that *Baſe* which *Vitruvius* calls *Attic*.

M. What is the Attic Baſe compoſed of?

P. PLINTH (A) two *Torus*'s (B and D) and (the) *Scotia* (C, with its Fillets) Fig. II.

M. What do you mean by the Word Scotia?

P. SCOTIA (Greek) *Skotos*, Darkneſs, called by ſome *Trochilus* from the Greek *Trochilos*, a Pully; 'tis a hollow Moulding between the *Tores* of a *Baſe*, as C. Fig. II.

M. What is the Height of the Dorick Column including its Baſe and Capital?

P. Eight Diameters when ſet alone, and ſeven when ſet in *Porticoes*, &c.

M. What is the Height of the Attick Baſe?

P. Half the Diameter or thirty Minutes preciſely.

M. Is the Capital of the ſame Height alſo?

P. Yes.

M. What are the Parts of the Dorick Capital?

P. Its *Abacus* L, *Ovolo* I, *Annulets* H, and *Hypotrachelium* G.

M. Is not the Aſtragal F *and its Liſt a Part of the Capital?*

P. No. They are a Part of the *Shaft* or *Column* E.

M. How many Parts is the Dorick Column compoſed of?

P. Four, viz. The *Aſtragal* and its *Fillet* or *Liſt*, the *Shaft* and the *Cincture* h.

M. Hath the Dorick Column any Ornament more than its Baſe, Shaft and Capital?

P. Yes, its *Fluteings*, called by the French *Cannelures*, and by others *Striures*, from *Striges*, Folds of a Garment, which *Vitruvius* ſays, they were at firſt deſign'd to repreſent.

M. What Number of Flutes is in the Circumference of a Dorick Column?

P. Twenty.

M. Are there as many in a Dorick Pillaſter?

P. Yes. A *Dorick Pillaſter* (as well as the *Ionick*, *Corinthian* and *Compoſite*) ought to have ſeven Flutes in each Face.

M. What do you call thoſe Spaces between the Fluteings?

P. *Striæ*, *Liſts* or *Fillets*.

M. What Proportion doth thoſe Fillets bear to the Flutes?

P. One third Part of the Breadth of a *Flute*.

M. Are Columns ever fluted without Fillets?

P. Yes. Frequently in the Dorick Order but no other.

M. What Depth are the Flutes to be cut?

P. About one third of their Breadth. Some are made Half their Breadth.

M. I have obſerved in Columns that their Fluteings have been filled up with a Swelling a third Part of the Column's Height from the Baſe, pray tell me what you call them?

P. Such *Columns*, whoſe *Flutes* are ſo filled, are call'd ſtav'd or cabled *Columns*.

M. Now let's return to the Entablature of this Order, and firſt explain the Architrave.

P. The *Architrave* of this Order ought to be ſolid and ſubſtantial, and never to have more than two *Facia's*, as M, N. Fig. II. with its *Tenia* or *Band* P which crowns it.

M. Is there never any other Ornament to the Dorick Architrave?

P. Yes. When the *Freeze* is enriched with its *Triglyphs*.

M. *What are thoſe Ornaments?*

P. GUTTÆ or *Drops*, placed under the *Tenia*, in ſuch Manner, as if they had flowed from the Channels of the *Triglyph* through the *Tenia*, and ſmall *Fillet* or *Moulding* under it.

M. *How many of thoſe Guttæ or Drops are plac'd under each Triglyph?*

P. Six, which are made flat as a *Triangle*, or round, like a *Cone* cut from the *Vertex*, perpendicularly to its *Baſe*.

M. *Are theſe Guttæ or Drops ever uſed in any other Part of this Order?*

P. Yes, in the *Plancere* of the *Corona*, and *Modilions*, and are 36 in Number.

M. What are the Ornaments of the Freeze?

P. Its *Triangles* and *Metops*.

M. Pray explain them.

P. 1. A TRIGLYPH, in Greek ſignifies a three ſculptured Piece, *quaſi tres habens Glyphas*, was firſt uſed in the *Delphic* Temple, repreſenting an *Antick Lyre*, which Inſtrument *Apollo* had been the Inventor; the *Italians* call them *Planetti*, ſmall Plains. Their Breadth is always equal to half the Diameter of the *Column*, or 30 Minutes, and Height to the Height of the Freeze, being crown'd with Part of the upper *Tenia* R. The two angular Hollows, being but half channell'd, are therefore called *Semicalicula*.

2. METOPS, from the Greek, *Metope*, *Meta* and *Ope* between three, is the ſquare Space in the *Freeze*, between the *Triglyphs*, which was anciently adorn'd with Ox's Skulls, Inſtruments us'd in Sacrificing, &c. But now, moſt properly with Fruit, Flowers, &c. when introduced in Gardens or

with the Arms of the Gentlemen to whom the Building belongs.

M. What is the chief Thing to be obſerved in Metops?

P. That they be truly ſquare.

M. What are the Parts of the Dorick Cornice?

P. The *Cavetto* S, the *Ovolo* T, the *Corona* W, the *Cima Recta* X, and *Inverta* Y, whoſe Total are five.

M. Pray explain the five Parts of the Cornice?

P. I will. Firſt, the *Cima Recta* Y is the ſame as W in Fig. I.

Secondly, The *Cima Inverta*, or *Inverſa* X, is of the ſame Reſemblance of the rouling Wave, as in *Cima Recta*, a Wave ready to fall with its hollow Part reſting upon the *Corona* at one Extream, and as if 'twere juſt falling from *Cima Recta* with the other. The *Corona* W already explained in *p.* 2, *&c.* 13, *&c.* as alſo is *Cima Reverſa* X, and *Cima Recta* Y.

M. Is not the Character of this Cornice threefold?

P. Yes. There is one very plain, as that of *Palladio, Serlio, Bullant, Cataneo, Barbaro* and *De Lorme,* who uſes neither *Mutules* nor *Dentels.*

Secondly, There is another more compounded, having *Dentils,* as at the Theatre of *Marcellus* at *Rome,* that of *Scamozzi* and *Vignola.* And

Laſtly, When *Mutules* is uſed without *Dentils.* The Ornaments of this *Cornice* being thirty ſix *Drops* (or *Bells*) cut under each *Mutule,* ſhould be ſhaped like ſmall *Cones,* whoſe Points or Tops are ſunk into the under Bed of the *Mutule* or *Corona.*

M. I find by the preceding, that Mutules and Dentils are often uſed, pray explain to me what Mutules and Dentiles are?

P. I will. MUTULI (from the Latin) is a little inverted *Conſole* under the *Soffit,* by us called *Modillion,* which al-

always ought to correſpond with the Middle of the *Columns.*

Theſe *Modilions* are particularly affected to the *Corinthian* Order, where they are always adorn'd with carved Works, &c. In the *Dorick, Ionick* and *Compoſite* they are more plain, having ſeldom any Enrichment, excepting a ſingle Leaf underneath.

Secondly, DENTICLES (a Member of the Cornice) immediately above the *Cymatium* of the *Freeze,* cut after the Manner of Teeth. Theſe are now particularly affected in the *Dorick* Order, notwithſtanding that anciently they were not admitted therein. The ſquare Member, whereon they are cut, is called the *Denticule,* and in Latin *Denticulus.*

Ionick Order.

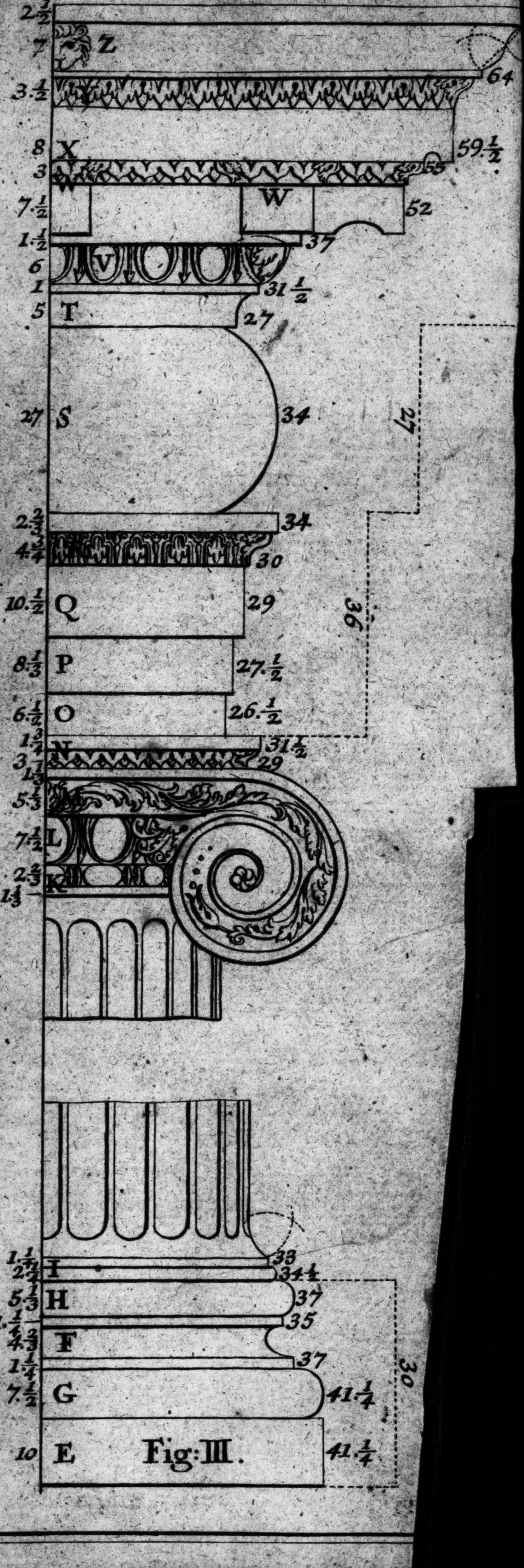

Fig: III.

Of the IONICK *Order.*

M. W*HY is the Ionick Order ſo called?*

P. Becauſe it was firſt invented by ION, in *Ionia*, a Province in *Aſia*, who is ſaid to have erected a Temple of this Order to the Goddeſs DIANA.

M. What doth the Ionick Order repreſent?

P. A Kind of feminine Slenderneſs, not like a light Houſewife, ſaith *Vitruvius*, but in a decent Dreſs hath much of the Matron.

M. I obſerve that the Ionick Baſe differs from the Dorick Baſe in the upper Part thereof, I deſire that you explain the Parts of that Baſe.

P. I will. Firſt the *Plinth* E, the lower *Torus* G, the *Scotia* F, and upper *Torus* H is already explained in the *Dorick* Order, and the *Aſtragal* I, compleats the whole *Baſe*, as required.

M. I underſtand your Demonſtrations very plainly, pray go through the whole Order in the ſame Manner.

P. I will, and begin with the *Capital*, and ſo proceed to the upper Part of the *Cornice*.

Firſt, The *Capital* which is compoſed of three Parts, *viz.* the *Abacus* N, the *Voluta* M, and the *Ovolo* L.

Secondly, The *Architrave*, compoſed of four Parts, *viz.* the *Cima Reverſe* R, the Firſt *Faſcia* O, the Second *Faſcia* P, and the third *Faſcia* Q.

Thirdly, The *Freeze* S.

Fourthly, The *Cornice* compoſed of ſix Parts, viz. The *Cavetto* T, the *Ovolo* V, the *Modillions* W, the *Corona* X, the *Cima Reverſa* Y, and the *Cima Recta* Z.

M. Is this Column ever fluted?

P. Moſt ſure, 'tis from this Order that the *Flutings* firſt were taken, and was originally made to repreſent the Folds of Garments.

M. How are theſe Flutings deſcribed on the Baſis of a Column?

P. Divide the Circumference of the *Baſe* into twenty four equal Parts, and each of thoſe Parts into four ſmaller. Give to each *Flute* three of thoſe ſmall Parts, and to each *Fillet* one, the Depth of each *Flute* muſt not exceed above one third of its Breadth.

M. How do you find the Centers of the Flutes?

P. Two Ways; as firſt, complete the *Equilateral Triangle* o, n, m, ſo ſhall, n, be the Center required, or,

Secondly, Complete the *Geometrical Square*, and draw its Diagonals, and the Center of the Geometrical Square ſhall be the Center of the *Flutes* required. See *Fig.* 15.

M. I underſtand you very well, I now deſire that you demonſtrate to me the Manner of deſcribing the Ionick Voluta.

P. I will, firſt, draw the *Aſtragal* A B, and through the Middle thereof the Line c, d; then from the Top of the *Abacus* let fall perpendicular to the former, another Line paſſing through the Center of the Circle or Eye of the *Volute*, as h, i. Within this Circle are the twelve Centers to be placed on which the *Contour* of the *Voluta* is deſcribed and are thus to be found. Deſcribe a Geometrical Square whoſe Diagonals are one in the Horizontal Line and the other in the perpendicular Line, croſſing each other in the Center of the Eye; from the Middle of the Sides of this Square draw two Lines which divide the *Square* into four, and each Line being divided equally into ſix Parts, gives the twelve Centers, or Points required, as they are numbred in the Eye of the *Volute*. To deſcribe the *Volute*, open your Compaſſes from No. 1. (in the Eye of the *Volute*) to that Place where the perpendicular Line cuts that of the lower Part of the *Abacus*, and draw a Quarter of a Circle, viz. continue it till it meets the Horizontal Line c, d. See *Fig.* 14.

Secondly, On the Point 2, place your Compaſſes, and open them to the Arch laſt deſcribed, and continue the Arch Line till it meets the Perpendicular h, i.

Thirdly, On the Point 3, place your Compaſſes, and open them to the Arch laſt deſcribed, and continue the Arch Line till it meets the Horizontal Line c, d.

Fourthly, On the Point 4, place your Compaſſes, and open them to the Arch laſt deſcribed, and continue the Arch Line till it meets the Perpendicular h i, and in like Manner, you may turn it about till you have turned off all the *Twelve Centers*, which will deſcribe the *Contour* of the *Volute* as required.

M. I obſerve that Twelve Centers deſcribe the Outſide Line; pray how is the Inſide Line deſcribed, ſo as to have a proportional Diminution?

P. This *Inſide Line* or *Border* is deſcribed by a ſecond Draught, in the ſame Manner as the firſt was, placing the fix'd Foot of the Compaſſes in *Twelve other Centers*, very near the firſt, *viz.* At the *fifth Part* of the Diſtance that is between the former, under which they ought to be reckon'd towards the *Center* of the *Eye*. Note, that theſe 12 Centers are repreſented in the *Eye* of the *Volute* by 12 Points, made larger than any other, on which the Inſide Line may be deſcribed as required.

Of the CORINTHIAN *Order.*

W*HY is the Corinthian Order ſo called?*

P. Becauſe it was firſt deſigned by an *Architect* of *Athens*, and executed at *Corinth*, from whence it had its *Original* and *Name* of *Corinthian Order*.

M. Is this Order ever fluted?

P. Yes, very often, more frequent than the *Ionick*.

M. How many Flutes are generally allowed to this Order?

P. Twenty Four, as in the *Ionick*, and ſometimes according to the *Compaſs* and *Station* of the *Column*; the Flutes may be augmented to *Thirty*.

M. What are the Parts *of the Corinthian Baſe?*

P. The *Plinth* A, the *lower Torus* B, the *Aſtragal* C, the *Scotia* D, the *upper Torus* E, and the *Aſtragal* F.

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Corinthian Order.

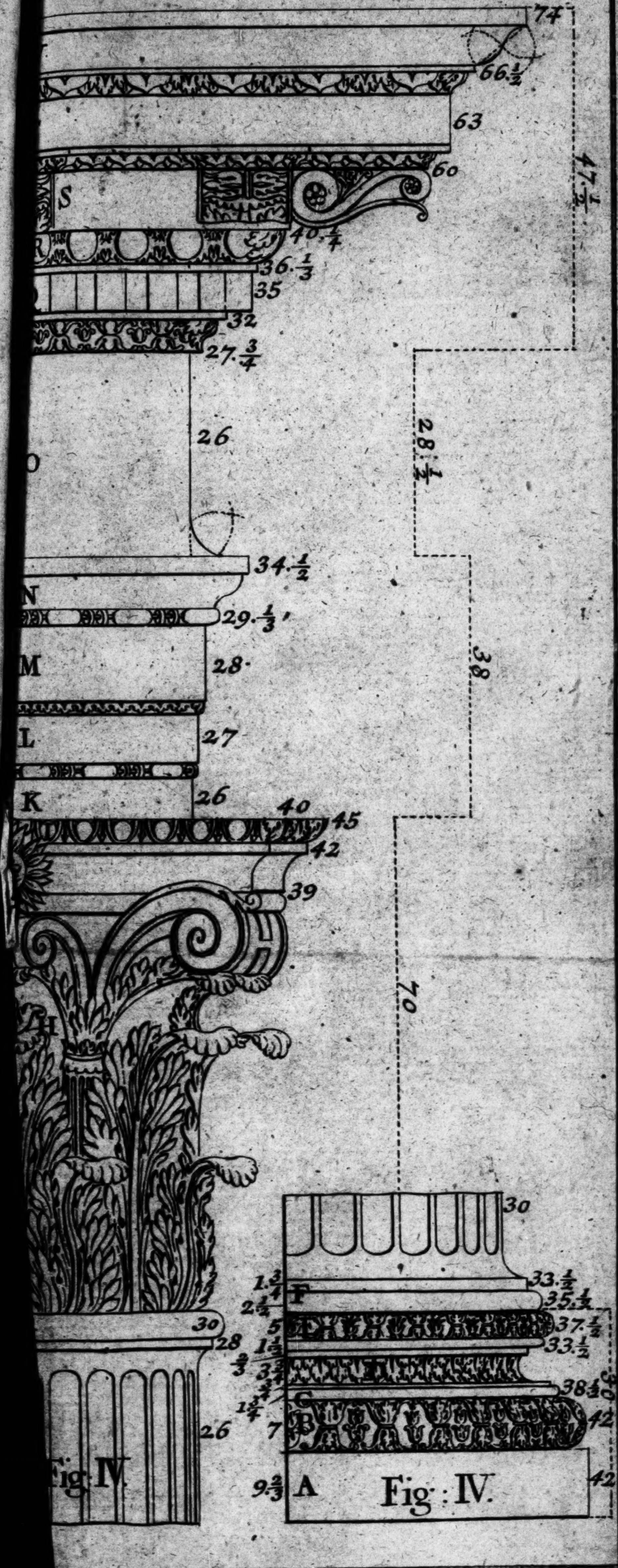

Fig IV.

Fig : IV.

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M. Pray go through the remaining Part of the Order.

P. I will.

Firſt, The *Capital* H, whoſe Leaves are the *Acanthus* or *Branca Urſina*, Bears Foot, *firſt invented by Callimachus*, an *ingenious Statuary* of *Athens* upon ſeeing this Plant ſpreading its ſelf around a *Basket*, that had been placed upon the *Tomb* of a young *Corinthian* Lady, and covered up with a Tile. The *Leaves* he imitated in his *Scrolles* or *Volutes*, the *Basket* in the *Vaſe* or *Tambour*, and the *Tyle* or Covering in the *Abacus* I.

Secondly, The *Architrave* compos'd of four Parts; *viz. Cima Reverſa* N, and the *three Facias* M, L, K.

Thirdly, The *Freeze* O, generally adorn'd with all Kinds of Figures and various Compartiments at Pleaſure.

Laſtly, The *Cornice* wherein are both *Dentelli* and *Modillions*, called by our Workmen *Teeth* and *Cartouzes*, conſiſting of ſeven Parts, viz. The *Cima* or *Cavetto* P, the *Dentils* Q, the *Ovolo* R, the *Cimaſium* and *Modillions* S, the *Corona* T, the *Cima Reverſa* V, and the *Cima Recta* W.

Of the COMPOSITE *Order*.

WHY is the Compoſite Order ſo called?

P. Becauſe 'tis *compoſed* of the *Ionick* and *Corinthian Orders*, and not a compleat *Order* of its ſelf. 'Tis of *Roman Extraction*, and by many is called the *Roman Order*, and by ſome the *Italian Order*.

M. What are the Parts of the Compoſite Baſe?

P. Six, The *Plinth* A, the *lower Torus* B, the *Aſtragal* C, the *Scotia* D, the *Upper Torus* E, and the *Aſtragal* F.

M. Pray go through the whole Order in like manner?

P. I will.

Firſt, The *Capital* M, compos'd of two Rows of *Leaves*, proper to the *Corinthian* and the *Volutes* of the *Ionic*.

Secondly, The *Architrave* compos'd of three Parts, viz. The *Cimaſium* Q, and the two *Facia's* P, O.

Thirdly, The *Freeze* R.

Laſtly, The *Cornice* which is compos'd of ſeven Parts, viz. The *Cima* or *Cavetto* S, the lower Part of the *Modillion* T, the upper Part of the *Modillions* V, the *Cimaſium* W, the *Corona* X, the *Cima Reverſa* Y, and the *Cima Recta* Z.

M. You having thus demonſtrated all the ſeveral Parts belonging to the Five Orders in Architecture, pray now ſhew me how to draw or delineate an entire Order in Architecture.

P. I will; but before we can come to the *Practice*, I muſt teach you a few *Geometrical Problems*.

PROB. I. Fig. 16.

To erect a Perpendicular, from a Point given in the Middle of a Line.

Let h, i, be a Right Line given, and 'tis required to raiſe the *Perpendicular* e d, from the given Point e. *Practice*, open the Compaſſes to any Diſtance, as e f, and make e g equal to *e f.*

With any Opening of your Compaſſes greater than f e, on f, deſcribe the Arch b b, and on g the Arch a a, interſecting the former in d, draw d e, and 'tis the *Perpendicular* required.

PROB. II. Fig. 17.

To draw a right Line parallel to a right Line given. Let it be required to draw the right Line i k, *parallel to the right Line* g h, *at the Diſtance of the right Line* a b.

Practice, Take the right Line a b, in your Compaſſes, and on any Part of the right Line g, h, as at c, deſcribe the Arch f f, and on any other Point towards the End of the Line g, h, as at d, with the ſame Opening deſcribe the Arch e e. If you lay a Ruler on thoſe two Arches, ſo as but juſt to ſee the Convexity of them, and draw a right Line, that Line ſo drawn ſhall be *parallel* to the right Line g, h, as required.

PROB. III. Fig. 17.

To make an Equilateral Triangle, whoſe Sides ſhall be equal to a right Line given. Let it be required to make the Equilateral Triangle a e d, *equal ſided to the given right Line* f, g.

Practice, Make d e, equal to f g, then with your Compaſſes on e, with the Opening e d, deſcribe the Arch c c; and with the ſame Opening on d, the Arch b b croſſing the former in a, join a d, and a e, and it will complete the

Equilateral Triangle, whoſe Sides ſhall be each equal to the given Line f g.

PROB. IV. Fig. 19.

To divide a right Line into any Number of equal Parts. Let it be required to divide the right Line a b, *into ten equal Parts.*

Practice, Draw a right Line at Pleaſure as *d e*, open your Compaſſes to any ſmall Opening, and run them along the Line *d e* ten Times, complete the *Equilateral Triangle c d e*, and from the Point *c*, through the ten Diviſions draw right Lines: *Laſtly*, Take the given Line in your Compaſſes, and place it from *c* to *g*, and from *c* to *f*, and draw *f g*, ſo ſhall the Line *f g*, which is epual to *a b*, be divided into ten equal Parts as required.

M. Theſe four Problems I underſtand; is there any other Thing neceſſary for me to know, before I begin drawing?

P. Yes, I muſt firſt remind you what is meant by *Modules* and *Minutes*, altho' I have ſaid ſome Thing thereof already; alſo what is meant by *Height* and *Projecture* of any Member, &c.

Firſt, A *Module* is the Diameter of a *Column* at its *Baſe*, divided into *ſixty equal Parts*, called *Minutes*.

Secondly, The Height of a Moulding, is the Thickneſs as is contained, between one and the other Moulding.

Thirdly, *Projecture*, ſignifies the *Prominency* or *Emboſſment*, which the Mouldings have, *beyond the Naked of the Wall*, which is always in Proportion to its *Height*, and herein *you* muſt *note* that *I ſet off all my Projectures from the Central Line of the Column*, and not from the Upright or Face of the *Column* as many do.

M. Which of the Five Orders, ſhall we begin with.

P. The *Dorick*.

M. What is the firſt Work to be done?

P. To make your *Module to work by*, which is taught by the *fourth Problem hereof*, to divide a right Line into any Number of equal Parts.

M. Of what Dimenſions ought this Module to be?

P. Let it be equal to the Line XX, Plate 2d, divided into ſixty equal Parts, or *Minutes*.

M, I obſerve in the Five Orders, that at the End or Projection of every Member there be Figures placed, as alſo between the Mouldings at the back Side; pray what do thoſe Figures ſignify?

P. Thoſe Figures placed at the *Extreams of the Mouldings* repreſent the *Number of Minutes* as thoſe *Mouldings* project from the *Central Line* of the *Column*, and the other Figures between the *Mouldings* at the *Backſide* repreſent the *Number of Minutes* as every Member is in Height. But to make the Thing more plain, I will draw *an entire*

tire Order, and for that Purpoſe I make Choice of the *Attick Baſe* with the *Dorick Order*.

F I G. VII. Plate II.

1. Make A B equal to *forty Minutes*, and on A, by the firſt Problem hereof erect the *Perpendicular* A N, which muſt repreſent the *Central Line* of the *Column*.

2. Take *ten Minutes* the Height of the *Plinth*, and ſet it from A to B, and draw B 40, parallel to A B; make A B and B 40, each equal to 40 Minutes, and join 40 B, ſo ſhall the *Plinth* be compleated.

3. From B to C ſet off ſeven Minutes and half for the Height of the *lower Torus*, and draw C K parallel to B 40, make C K equal to 36 Minutes $\frac{1}{3}$ as alſo B M, draw K M, and biſſect it in N, on which Point N, deſcribe the Semicircle M P K, ſo ſhall the *lower Torus be compleated.*

4. At the parallel Diſtance of one Minute and $\frac{1}{4}$, draw E L, which make equal to C K join L K, ſo will the *Fillet* be compleated.

5. At the parallel Diſtance of four Minutes $\frac{1}{2}$ draw F n, which make equal to thirty five Minutes, draw n L and biſſect it in m, whereon deſcribe the Arch n Q L, ſo will the *Scotia* be compleated.

6. At the parallel Diſtance of one Minute and $\frac{1}{4}$ draw G o, which make equal to F n, and join o, n, ſo ſhall the *Fillet* be compleated.

7. At the parallel Diſtance of five Minutes and half, draw H q which make equal to thirty three Minutes $\frac{1}{2}$, draw q o, and biſſect it in P, and on P deſcribe the *Curve* o R q, ſo ſhall the upper *Torus* be compleated.

8. Set up one Minute and Quarter from H to I for the Height of the Cincture, and draw I r, parallel, and equal to H q, join H q, and the Cincture is compleated.

9. Make H S equal to thirty Minutes, or r S equal to nine Minutes $\frac{1}{2}$ in Fig. 8,

and draw S t the Upright of the *Column* perpendicular to S L, make S t equal to double S q, and draw the Line t r, on r, with the Diſtance r t deſcribe the Arch t u, and on t, the Arch r u. *Laſtly*, on u with the Interval u r, deſcribe the Arch r t, and that will complete the *Attick Baſe*, as required, as alſo the Cincture or Baſe of the Shaft.

Having laid down the Manner of deſcribing the *Attick Baſe*, I ſhall now proceed to lay down the *Dorick Capital* and *Entablature*, to which I proceed.

1. Draw A a, equal to twenty eight Minutes.

2. At the parallel Diſtance of one Minute and half, draw B b, which make equal to A a, and join a b, alſo at the parallel Diſtance of three Minutes and half draw C e, equal to twenty eight Minutes, and deſcribe the Semicircle b, 30 e, ſo ſhall the *Aſtragal* be compleated.

3. Set up nine Minutes from C to D, and draw D f, parallel to G D, make C D, and D f, each equal to twenty ſix Minutes, and draw f d; ſo ſhall the *Freeze* of the Capital be compleated.

4. Set off three Minutes $\frac{1}{3}$ from D to E and draw E k, parallel to D f, and make E k, equal to thirty Minutes. Divide D E, into three equal Parts, and draw the Annulets g h i.

5. From E, ſet off ſix Minutes and half to F, and draw F n parallel to E L, making F n equal to thirty ſix Minutes, join n k, which divide into five equal Parts, and on k and n, with four of thoſe Parts, deſcribe the Arches, croſſing each other in m, on which Point with the Interval m n, deſcribe the Arch n k, ſo ſhall the *Ovolo* be compleated. Vide Fig. 10.

6. Set off ſix Minutes, from F to G, and $\frac{3}{4}$ and draw G o, parallel to F n, which make equal to 36 Minutes, make G o equal to F n, and draw o n, ſo ſhall the *Abacus* be compleated.

7. Set off two Minutes and two thirds from G to H, and draw H S, parallel to G o, and equal to thirty nine Minutes, as alſo draw I t, at the parallel Diſtance of one Minute and $\frac{3}{4}$, join t, S, and S o, (as ſhall be taught by and by) and the *Cimaſſium* will be compleated, which doth compleat the whole *Capital* as required. The next is the *Architrave*, *Freeze* and *Cornice*.

1. Make a A equal to twenty ſix Minutes.

2. Set up eleven Minutes, from a to B, and draw B c parallel to a A, and make B b equal to a A, and join b A, ſo will the firſt Faſcia of the *Architrave* be compleated.

3. Continue B b, to c, making it equal to twenty ſeven Minutes.

4. Set off fourteen Minutes and half, from B to C, and draw C d parallel to B c, make C d, equal to twenty ſeven Minutes, and draw d c, ſo ſhall the ſecond Faſcia be compleated.

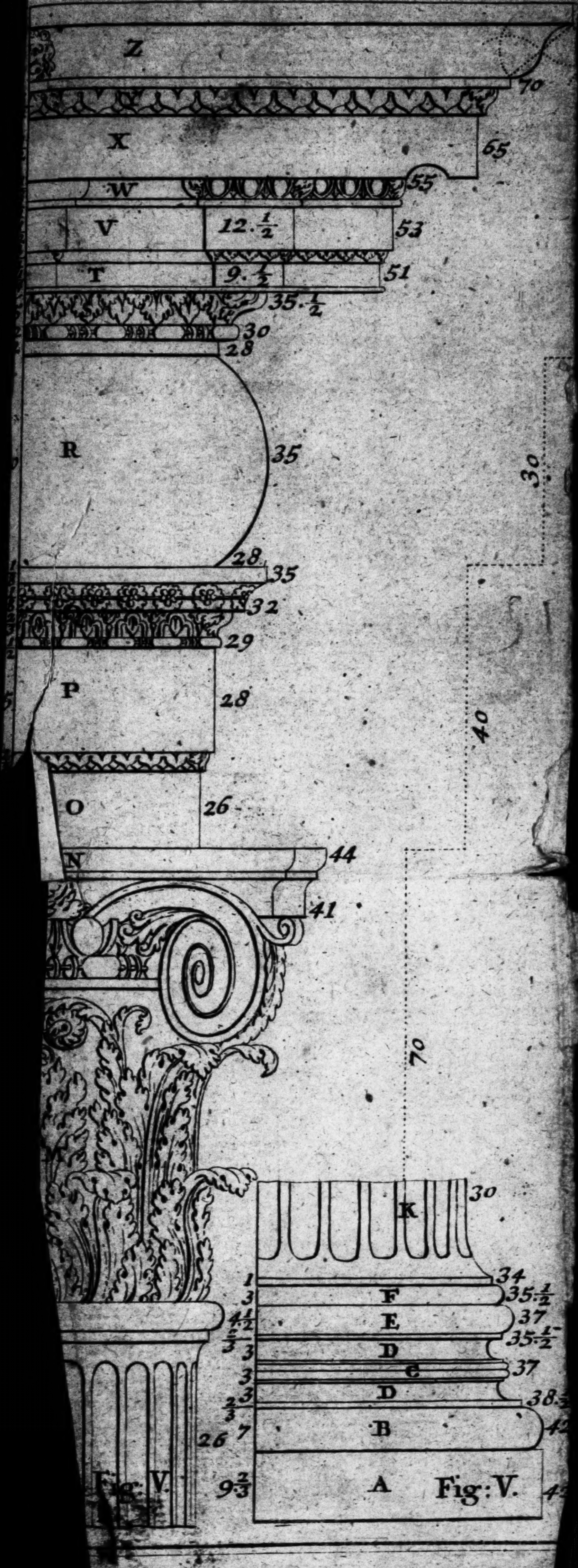
5. Continue C d, to e, making C e equal to thirty Minutes, ſet off four Minutes and Quarter from C to D, and draw D f parallel to C e, and equal to thirty Minutes, join f e, and the *Tenia* will be compleated, which doth compleat the *Architrave* as required.

6. Set up forty five Minutes from D to E, and draw E h, parallel to f D, make E h and D g, each equal to twenty ſix Minutes, and draw h g; ſo ſhall the *Freeze* be completed.

7. Set up five Minutes, from E to F, and draw F L equal to thirty Minutes and half, and parallel to E h, make E i, and F k, each equal to twenty ſeven Minutes, and join k i, ſo ſhall the Capital of the Trigliph be completed.

8. Set up five Minutes, from F to G, and draw G n, parallel to F l, make G n, equal to thirty five Minutes and half, alſo draw H o, equal to G n, at the parallel Diſtance of ¼ of a Minute and join o n.

Composite Order



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9. Make I z, equal to G F, ſo ſhall z be the *Center* whereon you muſt deſcribe the *Cavetto* n, z, I.

10. From H, ſet up ſix Minutes to I, and draw I r, parallel to H o, and equal to ſixty four Minutes and half, make I 2, equal to thirty nine Minutes and half, and draw g o, on o with the Interval o g, deſcribe the Arch g P, and with the ſame Diſtance on q, the Arch o P croſſing in P, on which *Center* deſcribe the *Ovolo* o 2.

11. Set up eight Minutes from I to K, and draw K S parallel to I r, and make K S equal to I r, join S r, and 'twill compleat the *Corona*.

12. Set up three Minutes and quarter from K to L, and draw L y parallel to K S, alſo at the Diſtance of three quarters of a Minute, draw M P, parallel to L y, and make each of them equal to ſixty eight Minutes, draw y t, Fig. 12. which divide in w, and with the opening w t, deſcribe Arches croſſing in u and x,

which are the *Centers*, to deſcribe the *Cima Reverſa*.

13. Set up ſix Minutes ¾ from M to O, and draw O S, parallel to M P, alſo draw N T, at the parallel Diſtance of two Minutes and one quarter, and make N T and O S, each equal to ſeventy ſix Minutes, and join T S.

Laſtly, Draw S P, which divide in V, and with the Diſtance V P, on P deſcribe the Arch V Q, and on V the Arches P Q and R S, and on S the Arch V R, ſo ſhall R and Q be the *Centers*, on which you may deſcribe *Cima Recta*, which doth compleat the whole *Entablature* as required.

M. Pray naw how do you deſcribe the Triglyphes of the Dorick Order.

P. I will ſhew you immediately; this *Ornament* is very rarely uſed in any Order beſides the *Dorick* and its Situation is always in the *Freeze*, placed exactly over the middle of the *Column*, its Height is always the ſame of the *Freeze*, and its Breadth is always equal to thirty Minutes;

every *Triglyph* is divided into ſeven Parts, *viz.* two entire *Glyphes* or *Channels*, (as z m), two *Semi Glyphes* as z i, and three *Spaces* or *Interſtices*, as, z l, *&c.*

To draw theſe *Triglyphes*, you muſt make D Z and E b, each equal to fifteen Minutes and draw b Z.

2. Divide E b, or D Z, into ſix equal Parts, and draw the Lines a b, a b, parallel to Z b, make b x, and a o, equal to two Minutes and daaw x o, alſo make, a o, a m, and a o, equal to two Minutes, and draw o m o.

3, On x deſcribe the Arch o n, and draw the Chord Line o n, alſo with the ſame opening on m, deſcribe the Semicircle o, n, o, and draw the Chord Lines o n, o n.

4. Draw the Lines b Z, a b, *&c.* through the *Tenia* towards o o o, *&c.* and draw q q, at the parallel Diſtance of five Minutes and half, from C d, alſo draw p p, at the parallel Diſtance of one Minute and half.

Laſtly, Draw right Lines from r r, *&c.* The Points of Interſection towards, c c, *&c.* the middle of the *Tenia,* till they meet the Line p p, and they will form the *Guttæ* or *Drops,* and compleat the *Triglyph* as required.

'Tis here to be obſerved alſo, that every *Triglyph* muſt be divided into twelve equal Parts, of which every entire *Channel,* as well as the *Spaces* between, lays claim to two Twelfths each, and the *Semi-Channel* at the *Extreams,* but to one Twelfth. When an *Entablature* is adorned with its *Triglyhs,* the ſquare Spaces between is called *Metops,* as is ſaid before, which muſt always be exactly ſquare. And from hence it happens, that in many Buildings the *Triglyphs* cannot be introduced.

M. Before we depart from this Diſcourſe, pray inform me how to deſcribe an Ovolo, Cima Reverſe and Cima Recta.

P. 1. An *Ovolo,* Fig. 10. the *Abacus* and *Annulets* being drawn, draw n k, which divide into ſive equal parts, on k and n, with the Diſtance of four of thoſe Parts deſcribe the Arches 4, 4, and 2, 2, croſſing in i m, the *Center* of the *Ovolo*, on which it may be deſcribed as required. *Ovolo's* are oftentimes deſcribed *Equilaterally* as the *Ovolo* H I, in the *Cornice* in Fig. 7.

2. *Cima recta*, Fig. 12. draw a i, which biſſect in o; with the Diſtance o i, deſcribe the Arches a m, m o, o h, h i, croſſing in h and m, the *Centers* of the *Cima Recta* required,

3. *Cima Reverſa*, Fig. 12. Let the Projecture be z m, which divide in ſix parts, make d y. and t b, each equal to one ſixth of z m; and draw y t, which biſſect in w, and deſcribing Arches Equilaterally croſſing in u and x the *Centers* on which you may deſcribe the *Cima Reverſa* required. *Cima Reverſa*, is alſo deſcribed as in Fig. 11. Let n b, be the *Projecture*, and n c the Height: draw b c, and biſſect it in e. Divide e c into

ſeven equal Parts, and on e and c, with the Interval of ſix of thoſe Parts deſcribe the Arches 4 g, 2 g, and on e and b, the Arches 5 f, 7 f, ſo ſhall the Interſections g and f, be the *Centers*, on which deſcribe the *Cima Recta* required.

M. I being thus far informed of the ſeveral Parts of a Column, as alſo how to draw an entire Order. I now deſire that you demonſtrate to me the Proportion, Diminution and Intercolumnation of the Five Orders of Columns in Architecture.

Of the Proportion, Diminution and Intercolumnation of the Five Orders *of* Columns *in* Architecture.

FIRST, The TUSCAN *Column*, including its *Baſe* and *Capital* is equal to ſeven Diameters in Height, and its *Entablature* to one fourth Part thereof. When it hath a *Pedeſtal* given to it, its Height is equal to two Diameters.

The *Diminution* of its *Shaft* at the *Aſtragal*, is one fourth of its Diameter at the *Baſe*.

The *Intercolumnation*, may be very large where 'tis required, becauſe the *Architrave* is commonly made of *Wood*, but the moſt uſual *Intercolumnation* is four Diameters of the *Shaft's Baſe*.

Secondly, The *Dorick Column*, its Height including the *Baſe* and *Capital*, is eight Diameters when alone; but when in Porticoes, *&c.* but ſeven Diameters: the Height of the *Capital* is always equal to thirty Minutes, as alſo is the *Baſe*.

The *Baſe* generally uſed to this *Order* is the *Attick*, for of its ſelf, it originally had no Baſe as may be ſeen by the Profiles of the *Bath* of *Diocleſian*. The Theatre of *Marcellus*, &c. at *Rome*.

The *Entablature* is commonly two Diameters in Height, and is very often adorned in the *Freeze* with *Triglyphs* and

Metops; and as I obſerved before, that anciently this *Order* had no *Baſe*, ſo 'tis to be underſtood of a *Pedeſtal*; ſo that when a *Pedeſtal* is introduced, *Palladio* allows two Diameters and one Third for its Height.

The *Diminution* of the *Shaft* at the *Aſtragal*, is equal to one fifth of the *Shaft's Baſe*, and the *Intercolumnation* is of three Diameters, excepting when the *Diſtribution* of the *Ornaments* in the *Freeze* require little more or leſs.

Thirdly, The *Ionick Column*, its height including *Baſe* and *Capital*, was anciently but eight Diameters, which the *modern Architects* thought too little, and therefore they added one Diameter more to give it *proper Stature*, ſo that its Height is nine Diameters. The Height of the *Entablature* is equal to one fifth of the *Column*, and its *Cornice* is ſometimes enriched with *Denticules*.

The *Diminution* of the *Shaft* at the *Aſtragal* is one ſixth Part of its *Baſe*. The height of the *Pedeſtal* is two Diameter and two thirds, and its *Intercolumnation*, two Diameters and one fourth, called by *Vitruvius*, *Euſtillos* as being the beſt kind of *Intercolumnation.*

Fourthly, The *Corinthian Column*, its Height including *Baſe* and *Capital* is nine Diameters and half, ſometimes nine and three quarters, and oftentimes ten Diameters. The Height of the *Capital* is ſeventy Minutes, of which the *Abacus* muſt be a ſixth or ſeventh Part, and the remaining Part being divided into three equal Parts, the two lowermoſt, gives the Height of the firſt and ſecond *Toure* of *Leaves*, and the third or uppermoſt part being divided into two equal Parts, the lower Part of the two ſhall be for the *Caulicula*, and the upper the *Extreams* of the *Voluta's*. The *Entablatures* Height is one fifth of the *Colnmn*, and the Height of the *Pedeſtal* one fourth of the *Column*. The *Diminution* of the *Shaft* at the *Aſtragal* is one ſeventh of its *Baſe*, and its *Intercolumnation* is, two Diameters and quarter as in the *Ionick*.

Fifthly, The *Compoſite Column*, its Height including *Baſe* and *Capital* is ten Diameters, and the Height of the *Entablature* is one fourth or one fifth thereof; its *Diminution* at the *Aſtragal* is one eighth Part of its *Baſe*, and the *Pedeſtal's* Height is commonly equal to one third of the *Column's* Height. The *Baſe* to this *Order* is, either *Attick* entirely, or a Compound of the *Ionick* and *Attick*; the *Intercolumnation* of this *Order* is one Diameter and half, and ſometimes one Diameter and three Quarters.

M. Pray now, how do you do to proportionate an Order to any height, and to find the Module or Diameter of the Column to work by.

P. Firſt, Your *Order* being agreed on you muſt account how many Minutes are contained in the height of the *Column* and its *Entablature*, and then divide the Height of your Room, *&c.* into as many equal Parts as there are Minutes in the Height of your *Order*, and taking ſixty of thoſe Parts that ſhall be the Diameter of your *Column* and *Module* to work by. The *Minutes* contained in the Height of the *Tuſcan Entablature*, is one Hundred and four. In the *Dorick* one Hundred and thirteen in the *Ionick* one Hundred and nine, in the *Corinthian* one Hundred and fourteen, and in the *Compoſite* one Hundred and twenty.

M. Pray how do you diminiſh Columns.

P. I will inform you.

1. Draw a Line repreſenting the *Centeral Line* of the *Column*, as A Q. Fig. VI.

2. As I have taught you before, draw the *Baſe* B.

3. Let C I be the Height of the *Shaft*, equal to ſeven Diameters, and draw L I K, parallel to the *Baſe* D C E.

4. Divide the *Shaft* C I, into three equal Parts, and make C F equal to one third and draw H F G, parallel to D C E.

5. Set off the *Semidiameter* of the *Column* from C to D, from C to E, from F to H, and from F to G, and draw D H and E G.

6. Set off twenty ſix Minutes (the *Diminution* being eight Minutes) from I to K, and from I to L.

7. On F deſcribe the Semicircle H F G, and make the Line *a a*, equal to K L, and parallel to H F G, and join K a, and L a, divide the *Segments* a H and a G into any Number of equal Parts (the more exact). But herein we ſhall make uſe but of four, at the Points *n m o* G, *&c.* and draw the Chord Lines *n n*, *m m*, and *o o*.

8. Let F I be alſo divided into four equal Parts, at the Lines X W, V T, and S R, which Lines muſt be drawn parallel to H G.

9. On, *n n*, erect two Perpendiculars, and continue them to S and R, alſo on M m erect two other Perpendiculars and continue them to V and T, and on *o o*, erect the Perpendiculars o X, and o W.

Laſtly, Lines being drawn from K to S, from S to V, from V to X, and from X to H, will form the *Diminution* of the *Shaft* or *Column* as required.

M. I think that by this time I am throughly informed of the ſeveral parts of the five Orders of Columns in Architecture, I now deſire that you'l inform me of the ſeveral Materials relating to Building.

Of the ſeveral Materials relating to Building.

WHAT are the Materials belonging to a Building?

P. Brick, Tile, Mortar, Timber, Lead, Iron, Nails, Laths, *&c.*

M. How are good Bricks to be choſen?

P. In every *Kiln* or *Clamp* there are three Degrees of Bricks. The firſt and worſt are thoſe that lie on the outſide of the *Clamp*, where the Fire has not power to burn them throughly, and theſe are called *Samell* Bricks. The next are thoſe within thoſe *Samell*, and the very beſt are they that are burnt in the Heart or Body of the *Clamp*, which if they have much of *Salt--Petre* in them will run, and be as it were glazed all over; But theſe for laſting, exceed all the reſt in that *Kiln*, notwithſtanding the Earth and making be the ſame.

M. Of what Magnitude ought every Brick to be.

P. Bricks have been made of divers Sizes, but the Statute takes notice but of one, *viz. That they be nine Inches in length, four Inches and half in breadth, and two Inches and half in thickneſs*; but you ſhall very rarely find them ſo, for the drying and burning, will ſhrink them in the thickneſs conſiderably, although it does, but very little in the length and breadth.

M. After what manner are Bricks ſold?

P. By the Thouſand, but for their price it is uncertain in reſpect of Fuel to burn them, ſervants Wages, the conveniency of Carriage, *&c.* But the general price about *Twickenham, Brentford*, &c. is from 12 to 14 *s.* a Thouſand.

M.

M. What number of Bricks may a good Bricklayer reaſonably lay in a Day ; having a diligent Labourer to ſerve him?

P. In *ſound* and *new Work*, a Bricklayer will lay a Thouſand of Bricks in a Day.

M. How many Bricks will compleat a Rod of Work at one Brick and half Thickneſs?

P. Four Thouſand and five Hundred.

M. What quantity of Lime and Sand do you allow to one Rod of Brick Work?

P. One Hundred and half or more of Lime and two Load of Sand.

M. By the Information I have received from you, I ſhall be able to make choice of good Bricks, and the quantity of Lime and Sand neceſſary for them, I deſire you to inform me ſomething in relation to Tiles?

P. Tiles are made of a kind of Earth which is much better than that of Brick, and not much unlike that as *Potters* uſe for their Ware. The ſorts of Tiles uſed in Buildings are principally two, *viz.* Plain Tiles and Ridge Tiles. Plain Tiles ſhould be in Length ten Inches and half, in Breadth 6 Inches, and in Thickneſs near three quarters of an Inch.

M. After what manner are Tiles Sold?

P. By the Thouſand, as Bricks are.

M. How is Tiling meaſured or rated?

P. By the Squars, which is ten feet every way, making a hundred ſquare Feet.

M. What quantity of Mortar is neceſſary to lay ſquare Tiling.

P. About one fourth part of what is allowed for a Rod of Brick-work.

M. What are the kinds of Wood that Laths ought to be made of, and of what Scantlings ought they to be, and in what parts of a Building ought the ſeveral ſorts to be uſed?

P. The ſorts of Laths allowed by Statute are principally of two ſorts, the one five Feet long, and the other four Feet long. Thoſe of five Feet long, have five Score or one Hundred in the Bundle, the other of four Feet have ſix Score, or 120 in the Bundle; their Breadth ought to be one Inch and half, and Thickneſs half an Inch, and of both theſe Lengths there are three ſorts.

Firſt, Heart of Oak.
Secondly, Sap-laths. And,
Laſtly, Deal-laths.

M. What is the Reaſon that Laths are made of different Lengths and Goodneſs of Stuff?

P. Becauſe that all Rafters upon which they are nailed, are not placed at equal Diſtances, and the Reaſon of the Variety of the Goodneſs of the Stuff, is always conſidered, for the Place wherein 'tis to be uſed; as for Example, Thoſe of Heart of Oak, being the beſt, are moſt neceſſary for Tiling, as being moſt durable; the ſecond Sort of Sap Laths, are beſt for plaiſtered Walls, and thoſe of Deal for Ceilings.

M. What Quantity of Nails is uſed in laying a Bundle of Laths?

P. Five Hundred to a Bundle of 5 Foot Laths, and 400 to a Bundle of four Feet Laths, every Hundred of Nails containing ſix Score.

M. How many Tiles will cover a ſquare Yard?

P. Threeſcore Tiles laid at a ſeven Inch Gage will cover a Yard. But as I ſaid before, Tiling is meaſured by the Square and not by the Yard.

M. How many Tiles and Laths ore required to complete a Square of Tiling?

P. Six Hundred ſixty five Tiles or there abouts, will cover a Square of Tiling, with one Bundle of Laths.

M. When you firſt mentioned plain Tiles, I remember that you at the ſame time mentioned Ridge Tiles, to what uſe ſerve they?

P. To cover the Ridge or Top of the Structure, and for every 1000 of plain Tiles you have ten Ridge Tiles.

M. I am very well ſatisfied as to the Knowledge of Bricks and Tiles, and the Appurtenances incident to their uſe in Building, as Sand, Lime, Laths, Nails, &c. *I now deſire that you give me the like Inſight in Timber?*

P. I will.

M. How many ſolid Feet of rough Timber make a Load?

P. Fifty ſolid Feet make a Load, and for Timber ſquared fit for Building, the following are proportioned, both for Depth and Thickneſs, or more plainly, the Sides of the Square at the end of the Piece.

	Feet		Feet		Inch		Inch
Summers or Girders from	14	to	16	In Length must be in their Square.	11	and	8
	16		20		13		9
	20		23		14		10
	23		26		16		12
	26		28		17		14

Joysts of	11½	In Length must be in their Square	8	and	3
			7		3
	10½		6		3

	Feet		Feet		Inch		Inch
Binding and Trimming Joyst from	7	to	11½	In length, must be in their Square	6	and	5
					7		5
					8		5

	Inch		Inch
Wall-Plates and Beams of any Length from 15 Foot, may have in their Squares	7	and	5
	10		6
	8		6

	Feet		Feet		Inch		Inch
Purlines from	15½	to	18½	In Length, must have in their Square	9	and	8
	18½		21½		12		9

	Foot		Foot		Inch		Inch	
Principal Rafters cut Taper from	12½	to	14½	In length, must have in their Square on one Side	8	to	5	The other Side 6
	14½		18½		9		7	7
	18½		21½		10		8	8
	21½		24½		12		9	8
	24½		26½		19		9	9

	Feet		Inch		Inch
Single Rafters in length from 6½ to 9½	6½ to 9½	Must have in their Square	4	and	3½
			5		4

Principal

Principal Diſchargers of any Length from	Feet 10 upward	Muſt have in their Square	Inch 13 12 and 15 13

M. I ſuppoſe that theſe are the principal Timbers belonging to the Building of any ordinary Edifice, in which I am well eſtabliſhed; I think that at the firſt you mentioned Lead amongſt the reſt.

P. 'Tis true I did, and 'tis a very uſeful Material, not only for Covering of Temples, Churches, *&c.* But in common Buildings for Gutters, Pipes, *&c.* to convey the Water from the Houſe into ſome convenient Place.

M. What Thickneſs ought Lead to be of for Gutters?

P. The thinneſt is moſt generally uſed as being moſt pliable, and is commonly about eight or nine Pound to the Foot.

M. What Allowance hath the Plumber for caſting old Lead, and Workmanſhip.

P. They are generally allowed Three Shillings per Hundred Weight.

M. What are Plumbers allowed per Pound for Sother?

P. According as the Allay is with Lead, from 9 *d.* to 12 *d.* per Pound.

M. Is not Iron a very conſiderable Material in Building?

P. Yes, for making Bolts, Hinges, Dogs, Staples, Window-Bars, *&c.*

M. At what Price is ſuch Work commonly done for?

P. At Four Pence, or Four Pence Half Penny per Pound.

M. Are Caſements made by the Pound?

P. No, Caſements are valued according to their Magnitude, Strength and Goodneſs of Workmanſhip, from Four Shillings to Twenty Shillings a Caſement, and the like for Locks, Keys, *&c.*

M. There is one thing yet remaining, in which if you ſatisfy me, I ſhall be highly obliged, and that is, how to meaſure Superficies and Solids, and the Manner of meaſuring the ſeveral Parts of a Building?

Of the Menſuration of Superficies and Solids, and the Manner of meaſuring the ſeveral Parts of a Building.

M. H*OW many Kind of Meaſures are uſed in Building?*

P. Three, *viz.* Lineal, Superficial and Solid.

M. What is Lineal Meaſure?

P. Lineal Meaſure, is the Meaſuring of any Thing that hath Length only, as a Line, *&c.*

M. What is Superficial Meaſure?

P. Superficial Meaſure is the Meaſuring of any Subſtance that hath Length and Breadth only, as Land Pavement, Painting, Plaiſtering, *&c.*

M. What is Solid Meaſure?

P. Solid Meaſure is the Meaſuring of any Quantity, that hath Length, Breadth and Depth, as Stone, Timber, *&c.*

M. What are the principal Meaſures, as are confirmed by Statute, or Cuſtom, uſed in Buildings?

P. The Foot, the Yard, and the Rod, Pole or Perch.

M. From whence have they their Original?

P. From a Barley Corn, for 'tis confirmed by the Statute of *Edw.* III, That three Barley Corns in Length ſhould make an Inch, 12 Inches a Foot, 3 Foot a Yard, and 16 Feet and an Half a Rod, Pole or Perch.

M. Pray inform me what is a Superficial Foot?

P. A Superficial Foot is a Foot in Length, and in Breadth, containing 144 Inches, by which is meaſured, Plank, Glaſs, Pavement, &c.

M. What is a ſolid or cubical Foot?

P. A ſolid or cubical Foot, is a Body ike unto a Die, each Side being equal o one Foot or twelve Inches, and the whole equal to 1728 Inches; by this Meaſure, Stone, Timber, &c. are meaſured.

M. What is a Yard Square?

P. A Yard (as is ſaid before) is a Length equal to three Feet, and a ſquare Yard is equal to nine Feet, that is, three Feet multiplied by three Feet, produces nine Feet; by this Meaſure do *Paviours, Plaiſterers, Joyners, Painters,* &c. ſometimes meaſure their Work. And a Yard Solid or Cubic, conſiſts of 27 ſolid Feet.

M. What is a Pole, Rod or Perch.

P. A Pole, Rod or Perch in Length only, is a Length of ſixteen Feet and half, but a ſquare Rod contains 272 Feet and a quarter, produced by multiplying 16 Feet and half, by 16 Feet and half; by this Meaſure of 272 Feet and quarter, Land and Brick-work is meaſured, as alſo digging of Ground for Buildings, &c

M. Is there not any other kind of Meaſure uſed in Building?

P. Yes, but principally in the *Bricklayers* and *Carpenters* Works, which they call the Square of ten Feet, *viz.* ten Feet every way, the whole Square being equal to 100 Feet, aud by this Meaſure *Carpenters* meaſure their *Carcaſs*, *Framing*, *Roofing*, *Partitioning*, *Flooring*, and the *Bricklayers* their *Tiling*, and thus much for the Explanation of Meaſures: and becauſe that the uſual way of taking Dimenſions is by Feet and Inches, I ſhall now proceed to ſhew you how to multiply Feet and Inches by Feet and Inches; before that I come to particular Examples in Menſuration.

EXAMPLE I.

Let it be required to multiply 14 Feet 7 Inches by 17 Feet 11 Inches. Place the Numbers to be multiplied, in order one under another, *viz.* Feet under Feet, and Inches under Inches, making a Croſs between the Feet and Inches, and drawing a Line under them as in the Margin.

Feet *Inch*
14—7
+
17—11

98
14
9—11
12—10
6—5

261 03 5

Firſt, Multiply the 17 Feet by 14 Feet, and they produce 238, which place down according to the common Practice of Multiplication, which herein happens to be in two Numbers, *viz.* 98, and 14.

Secondly, Multiply 17 Feet by the 7 Inches, and they produce 119, which divided by 12, give 9 Feet 11 Inches.

Thirdly, multiply the 14 Feet into the 11 Inches, and they produce 154, which divided by 12, gives 12 Feet 10 Inches,

Fourthly, Multiply the Inches into themſelves, and they make 77, which divided by 12, gives 6 Inches and 5 Parts.

Laſtly, Add the whole together, and the Sum will be 261 Feet, 3 Inches and 5 Parts.

EXAMPLE II.

Let it be required to multiply 327 Feet 5 Inches, by 30 Feet 7 Inches.

Feet	*Inch*	
327	05	
+		
30	07	
9810		
12	6	
190	9	
	2	11
10013	5	11

Firſt, Multiply 327, by 30, according to the common Way of Multiplication, and they produce 9810 Feet.

Secondly, Multiply the 30 Feet into the 5 Inches, and they produce 150, which divided by 12, gives 12 Feet and 6 Inches.

Thirdly, Multiply 327 Feet by 7 Inches, and it produces 2289, which divided by 12, gives 190 Feet and nine Inches.

Fourthly, Multiply the Inches into themſelves, and they produce 2 Inches 11 parts.

Laſtly, add the whole together, and the Sum will be 10013 Feet, 5 Inches and 11 parts.

M. I underſtand the nature of multiplying Feet and Inches by Feet and Inches perfectly well; I now deſire that we may proceed to the Menſuration of ſuperficial Figures, and firſt I ſhould be glad to know, by what Name each Figure is called?

P. You

P. You ſhall; *Superficial Figures* are either the *Circle*, *Ellipſis* or *Oval*, *Triangle*, *Square*, *Parallelogram*, *Rhombus*, *Rhomboydes*, *Trapezium*, *Pentagon*, *Hexagon*, *Heptagon*, *Octagon*, *Nonagon*, *Decagon*, &c. or Figures of many unequal Sides, of which each in its proper Place.

Firſt, Then the Circle, a plain *Geometrical Figure* contained in one Line only, in the midſt whereof there is a Point called the Center, from whence all Lines drawn to the Circumference are equal, ſo *a b* is equal to *a d*, and *a d* to *a c*, &c. The Proportion that the Diameter of any Circle hath to the Circumference is as 7 to 22, or (more exact) as 113 to 355. To meaſure the *Area* or *Superficial Content* of any *Circle*, obſerve this GENERAL RULE.

Square the Diameter (which is to multiply it into its ſelf) and multiply that Product by 11, and the laſt Product divide by 14, the Quotient ſhall be the Content of the *Circle* required. As for Example, a *Circle* is 12 Feet Diameter, what's the Content.

Or

12 the Diameter
12

144 the Diameter ſquared.
11

144
144

1584, which divide by 14, as above.

14)1584(113 the Content of the Circle requir'd.
14··

18
14

44
42

2 Remains

Or multiply half the Diameter by half the Circumference, the Produce is the *Area* or *Superficial Content*.

Secondly, An *Ellipſis*, Fig. XXI. *Greek*, an *Oval*, or *Geometrical Figure* comprehended in one only Line, but that not *Circular*, nor having all its Parts equally reſpecting the Center. But from two *Focus* Points. To meaſure the *Area* or *Superficial Content* of any *Ellipſis*: Take this GENERAL RULE, multiply the *Tranſverſe* by the *Conjugate* Diameter and *extract the ſquare Root* of their Product. That Root ſo extracted, ſhall be equal to the Diameter of a Circle whoſe ſuperficial Content ſhall be equal to the *Ellipſis* given, which may be found by the preceeding Rule for a Circle.

Thirdly, Right lined *Triangles*, of what Form ſoever are meaſured by either of theſe GENERAL RULES.

1. Multiply half the length of the *Baſe* by the whole length of the Perpendicular, and the Product ſhall be the Content required. Or,

2. Multiply half the Perpendicular, by all the *Baſe*, and that Product ſhall be the Content required, Fig. 22.

Fourthly, The *Geometrical Square*, Fig. 23. is meaſured by multiplying, one Side by the other, as alſo is the *Parallelogram* Fig. 24.

Fifthly, The *Rhombus g i k l*, Fig. 25. Let fall the Perpendicular *k h*, which multiply by any of the longeſt Sides as *k l*, or *g i*, and the Product ſhall be the Content required.

Sixthly, The *Trapezium m*, Fig. 26. Divide it into two *Triangles*, and meaſure each ſeperately, as before is taught, and then adding the Sums of both Triangles together, you will have the Content of the *Trapezium* as required.

Seventhly, The *Pentagon* Fig. 27. from the *Center a*, draw *a b*, *a c*, and let fall the Perpendicular *a d*; meaſure the *Triangle a b c*, as before is taught, which Content multiply by 5, and the Product is the Content of the *Pentagon* required, and here you muſt note that what is here ſaid of the Menſuration of a regular *Pentagon*, the ſame is to be underſtood in the Menſuration of a *Hexagon*, *Septagon*, *Octagon*, &c. When you have any unequal-ſided Figure to meaſure, as Fig. 28. you muſt divide it into Triangles, marking each with an Alphabetical

Letter or a Figure, then beginning with the firſt Taiangle as that marked *A*, find its Content, and place it down as in the Table, and in like manner, go through with the whole; and laſtly by adding all the ſeveral Triangles together, you will have the whole Content of the unequal-ſided Figure as was required.

A	06	03	27
B	02	01	19
C	07	01	12
D	06	02	10
E	05	02	29
Total	28	03	25

M. I comprehend the Menſuration of Superficies perfectly well, I now deſire that you inſtruct me in the Menſuration of Solids?

P. I will. All *Solids* do conſiſt of three Dimenſions, *viz. Length, Breadth* and *Depth*, or *Thickneſs*.

M. What are the Solids I muſt learn to meaſure?

P. The *Cube, Parallelipipedon, Pyramis, Cone, Fruſtrum* of *Pyramids* and *Cones, Cylinders, Globes*, &c.

M. How do you meaſure the Cube A. Fig. 29.

P. A *Cube* is a *ſolid Body,* conſiſting of ſix ſquare Faces, or Plains, whoſe Sides are all equal, and Angles all right Angles. Let a *Cube* be 7 Feet 7 Inches ſquare, what's the Content. *The general Rule* for meaſuring of a *Cube,* is to find the Superficial Content of one Plain, and multiply that into the Depth, and the Product ſhall be the Content required.

EXAMPLE.

	Feet	*Inches*		
The Side of the Cube	7	7		
multiplied by	7	7		
	49			
	4 :	1		
	4 :	1		
		41		
The Superficial Content of one Plain	57	6	01	
which multiplied by the Depth	7	7		
	399			
	3	6		
	33	3 :	6	7
		3	6	
The ſolid Content required	436	10	0	7

Note, That what is here ſaid of the Menſuration of a *Cube,* the ſame is to be underſtood of the long *Cube* or *Parallelpipedon* B.

M. How do you meaſure the Solidity of a Pyramis or Cone?

P. The *Solidity* of a *Pyramis*, is found the very ſame Way as the *Solidity* of a *Cone*, which is by multiplying the Area of the *Baſe* by one third of the Height, and the Product is the *Solidity* of the *Cone* or *Pyramis* required. As for Example, *Fig*. C. Let the Superficial Content of the *Baſe* of the *Cone* be 20 Feet and the Perpendicular Height 15 Feet 3 Inches; multiply 20 Feet by 5 Feet 1 Inch, and the Product ſhall be equal to 101 Feet 8 Inches, which is the *Solidity* of the *Cone* required.

M. How do you meaſure the Solidity of a Priſm or long Triangular Solid?

P. Firſt, Find the Superficial Content of one End, (which is a Triangle as is taught before in Superficies) and multiply that Content by the Length, and the Product is the *Solidity* required. As for Fxample, Fig. D. The Content of the Triangular End is 2 Feet 9 Inches which multiplied by 30 Feet 7 Inches the Length, gives 84 Feet 1 Inches $\frac{1}{4}$, for the *Solidity* required.

M. Suppoſe there is a regular Solid, as Fig. E. *how is it to be meaſured?*

P. Let the *Solid* be a *Pentagon* at its *Baſe*, each ſide equal to 8 Feet, and the Perpendicular equal to 6 Feet: and its Length 20 Feet, what's the ſolid Content?

Firſt, Find the Superficial Content of the *Pentagon*, as before is taught in *Superficies*.

Secondly, Multiply the Length by the Content of the *Pentagon*, and the Product is the *Solidity* required; as for Example, the Superficial Content of the *Pentagon* is 120 Feet, which multiplied by 20 Feet the Length, gives 2400 for the *Solidity* required.

M. How do you meaſure an Irregular Solid, whoſe Ends conſiſt of unequal Sides and Angles, as Fig. F.

Let this irregular *Solid* be given to be meaſured.

Firſt, Find the Area of the *Baſe* as before is taught, which according to the

Dimenſions placed to the *Diagonal* and *Perpendiculars* will be found to be 2 Feet 4 Inches and an half, which multiplied by 47 Feet 6 Inches the Length, gives 110 Feet, 10 Inches for the *Solidity* required.

M. How do you meaſure the Solidity of a Cylinder?

P. By the very ſame Rules as before delivered, *viz.* find the *Area* of one End, and multiply that into its Length and the Product will be the *ſolid Content* required.

M. How do you meaſure the Superficial Content of a Cylinder?

P. Multiply the Length by the Circumference, and to that Product add the *Area* of both Ends, and the Sum ſhall be the Superficial Content required.

M. How do you meaſure the Superficial and Solid Content of a Globe?

P. I will inform you.

Firſt, For the *Superficial Content*, multiply the Diameter of the Globe, by its own Circumference, and the Product ſhall be equal to the *Superficial Content* required.

Secondly, For the *Solid Content*, cube the Diameter, which multiplied by 11, and its Product divided by 21, the *Quotient* will be equal to the *Solidity* required,

M. Theſe Solids which you have now taught me to meaſure are all regular, which in Practice ſeldom happens, not but that they are abſolutely neceſſary to be known; I now deſire you to inform me whether there are not certain Solids which moſt Timber Trees repreſent?

P. Yes, there are, and which are called *Fruſtrums* of *Pyramids* or *Cones*.

M. How are they meaſured?

P. As follows,

Firſt, Find the ſuperficial Content of each end of the *Fruſtrum*.

Secondly, Multiply the ſuperficial Content of one end by the other, and extract the ſquare Root of their Product.

Laſtly, This ſquare Root being added to the Sum of both *Areas*, and their Sum multiplied by one third of the *Fruſtrum's* length, the Product ſhall be the ſolid Content required.

Note, That what is here ſaid of the Menſuration of the *Fruſtrum* of a *Cone*, the ſame is to be underſtood of the *Fruſtrum* of a *Pyramid*, the *Rule* being common to both.

M. We having now gone through the Menſuration of Superficies and Solids, let us now return to the Building, and conſider of the ſeveral Meaſures that Workmen uſe in taking their Dimenſions.

P. Firſt, Of the CARPENTER, whoſe principal Work in *Partitioning*, *Roofing* and *Flooring*, all performed by the *Square*.

The principal Things to be obſerved in taking theſe Dimenſions, are as follows.

1. In naked Flooring to allow 9 or 10 Inches, for the Length of Joiſt laid in the Wall.

2. In boarded Flooring, you muſt take your Dimenſions to the very extream Parts, out of which, Deductions muſt be made for Stair-Caſes, Chimneys, *&c.*

3. In meaſuring Partitions, no Deductions muſt be made for Windows, Doors,

and Door-Caſes, if not agreed on otherwiſe.

4. When you take the Dimenſions of a Roof, meaſure the Length of the Rafter, and Length of the Roof inſtead of allowing Flat and Half the common Way.

5. Doors, Saſh-Windows, Shop-Windows, *&c.* are taken, and meaſured by the Foot Superficial.

6. Stairs and Stair-Caſes, are valued by the Step, according to the Goodneſs of the Stuff and Workmanſhip.

7. *Cornices* are meaſured by the Foot Superficial, and ſometimes by running Meaſure, as alſo are *Rails* and *Balluſtrades*, *Skirting-Boards*, *Breſtſomers*, *Lintelling*, &c.

Secondly, Of GLAZIER's Work, whoſe Dimenſions are taken in Feet, Inches and Parts, or rather by Feet, and the hundred Parts of a Foot Decimally; the principal Things to be obſerved therein: Are,

1. Where Windows in a Building are all of one Magnitude, you need meaſure

but one, and by that account for all the others.

2. To meaſure circular and oval Windows as ſquare Windows, of the ſame Breadth as their own Diameters, becauſe that in cutting out of the Quarrels of Glaſs, there is a great Waſte, and more Time ſpent therein than if 'twas a ſquare Window.

Thirdly, JOYNER's Work which moſtly is meaſured by the Yard Square. The principal Things to be obſerved herein is:

1. That their Dimenſions are taken in Feet and Inches.

2. That they girt down every *Moulding*, contained between the Cieling and Floor, which they take for the Height of the Room, and the Circumference of the Room they take for the Length, deducting the Doors, Windows and Chimney.

3. The Seats of Windows, *Cheeks*, *Sophetas*, &c. are all to be taken by themſelves, as alſo are Doors and Window-Shutters which are allowed Work

and half Work in regard to their being worked on both Sides, but for the moſt part by the Foot Superficial.

4. When *Pilaſters* or *Columns* are introduced, they are paid for according to the Goodneſs of their Work; but for *Architraves*, *Cornices*, *Sub-baſe*, &c. made ſingly they are meaſured at —— *per* Foot Running Meaſure or Superſicial; Saſh-Frames and Saſhes are at —— *per* Foot ſuperficial when together, or Saſhes ſingly, but the Frames ſingly at —— *per* Frame.

Fourthly, Of PAINTER's Work meaſured as the *Joyners* in every reſpect, excepting that of Work and Half, which the Painter hath none, for inſtead of accounting Doors and Window Shutters Work and Half, they make it double Work being painted on both Sides.

Window-Lights, Saſh-Frames, Saſh-Squares, Door-Caſes, Caſements, &c. are done at —— *per* Piece, and oftentimes *Modillion Cornices*, &c.

Fifthly, PLAISTERER's Work, principally of two Kinds:

1. Work Lathed and Plaiſtered, called Cielings. And,

2. Work Rendered, which is alſo of two Kinds, *viz.* Rendering upon Brickwork, or in Partitioning between Quarters. The principal Things to be regarded herein: Is,

1. To make Deductions for Chimneys, Doors and Windows, excepting where Rendering is done upon Brick, then there muſt be no Deductions made for Door or Windows, for the Work of the *Jaums* and *Heads* commonly exceed the Quantity of the Doors and Windows.

2. If the Workman find Materials, for Rendering between Quarters, you muſt deduct one fifth Part for Quarters, Braces, &c. But if Workmanſhip only is found, you muſt meaſure the Whole as whole Work, for the Workman could have performed the Whole much ſooner if there had been no Quarters there.

3. In meaſuring Whiting and Colouring between Quartering, there muſt be a fourth Part allowed extraordinary for the Returns of the Quarters.

Sixthly, MASON's Work, which is meaſured by Foot Meaſure, *viz.* either Lineal as the Coping of Walls, (which is oftentimes meaſured by the ſquare Foot alſo) or ſuperficial as in Pavements, or ſolid, as Blocks of Marble, Columns, *&c.* The principal Things to be obſerved herein is, that they girt all their Mouldings as *Joyners* do, and take their Dimenſions in Feet, Inches and Parts.

Seventhly, of BRICKLAYER's Work.

The principal Works in a Building performed by a Bricklayer are Walling and Tyling, and what is to be obſerved therein is:

1. That the Meaſure by which Brickwork is meaſured, is a ſquare Rod, or 16 Feet and half ſquared, equal to 272 Feet $\frac{1}{4}$.

2. That the Manner of meaſuring any Brickwork, hath no ſort of Difference from any other ſuperficial Meaſure, provided that the Thickneſs be equal to the Standard Thickneſs, *viz.* one Brick and half.

3. If the Thickneſs of Brickwalls are leſs or more than the Standard Thickneſs, then they muſt be reduced to the Standard Thickneſs by this GENERAL RULE.

Multiply the Number of ſuperficial Feet, found to be contained upon the Superficies of the Wall, by the Number of half Bricks, which that Wall is in Thickneſs; one third Part of that Product ſhall be the Content of Brickwork required, reduced to the Standard Thickneſs of one Brick and half. Therefore you muſt divide the Product produced by the Multiplication of half Bricks, by 3, and the Quotient will be the true Content required.

4. That you obſerve the ſeveral Thickneſſes of the Walls, and that you make

every Deduction out of its proper Thickneſs.

5. When you meaſure two Walls that conſtitute an *Angle*, the Length of one muſt be taken to the Outſide, and the other to the Inſide.

6. When you meaſure Chimneys, you muſt meaſure them as a ſolid Wall, and deduct the Vacancies, and not to girt them, as many do.

7. Beſides this rough Brickwork (as I may call it) there is other Kind of walling performed by Foot Meaſure, and ſuch is *Facio's*, *Arches* over *Doors*, *Windows*, &c. *Architraves*, *Freezes*, *Cornices*, *Ruſticks*, *Returns*, &c. *Peers*, *Columns*, *Pillaſters*, &c. all which are valued according to the Goodneſs of the Work.

8. The principal Thing to be obſerved in Tiling is that 'tis meaſured by the Square of ten Foot, as *Carpenters* meaſure their Roofs.

9. You muſt obſerve in taking the Dimenſions of Tyling, that you meaſure the whole Length, that is, as far as the

Tiles are laid for your Length, and take from the Ridge to the Eves for your Breadth or Depth, and thereby you will have the true Content of Tyling required, but deduct Chimneys out of it.

10. When many Hips and Valleys happen in a Roof, they muſt be paid for at——*per* Foot running Meaſure. Beſides all the above Works there comes to the *Bricklayers* Hands the Paving of Kitchens, Cellers, *&c.* with Brick, which Work is meaſured by the ſquare Yard of 9 Foot ſquare.

M. You have given me ample Satisfaction in every Particular, for which I am your moſt obliged, &c.

P. And as I have thus demonſtrated to you the ſeveral ways of meaſuring Superficies and Solids, and the Remarks to be made in taking the Dimenſions of the ſeveral Workman's Works, I will now proceed to lay down divers uſeful Tables, of great Uſe in caſting up the Expence of Buildings, *&c.*

TABLE I.

An Inſpectional Table, exhibiting the Price of any Number of odd Feet of Brickwork, (or other performed by the Rod) calculated from one Foot, to 34 Feet, (or a half quarter of a Rod) and at any Price from 1*s.* to 10*l.* the Rod.

The Price of any Number of Feet under 34 Feet or half quarter of a Rod.

Price of the												
Rod	1s.			2s.		6d.	5s.			10s.		
¾ Rod	9d.			1s.	10d.	2½	3s.	6d.		7s.	6d.	
½ Rod	6d.			1s.	3d.		2s.	6d.		5s.		
¼ Rod	3d.			7d.	2		1s.	3d.		2s.	6d.	
⅛ Rod	1d.		2q.	3d.	3q.			7d.	2q.	1s.	3d.	
	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.
33				0	3	2	0	7	1	1	2	1
32				0	3	2	0	7	0	1	1	3
31				0	3	1	0	6	3	1	1	2
30				0	3	1	0	6	2	1	1	0
29				0	3	0	0	6	1	1	0	2
28				0	3	0	0	6	0	1	0	0
27				0	2	3	0	5	3	0	11	3
26				0	2	3	0	5	2	0	11	0
25				0	2	2	0	5	1	0	10	3
24				0	2	2	0	5	0	0	10	1
23				0	2	1	0	4	3	0	9	3
22				0	2	1	0	4	2	0	9	1
21				0	2	0	0	4	1	0	9	0
20				0	2	0	0	4	1	0	8	2
19				0	1	3	0	3	3	0	7	0
18				0	1	3	0	3	2	0	7	2
17				0	1	2	0	3	2	0	7	0
16				0	1	2	0	3	1	0	6	3
15				0	1	2	0	3	0	0	6	1
14				0	1	1	0	2	3	0	5	3
13				0	1	1	0	2	2	0	5	1
12				0	1	1	0	2	2	0	5	0
11				0	1	0	0	2	1	0	4	2
10				0	1	0	0	2	0	0	4	0
9				0	0	3	0	1	3	0	3	2
8				0	0	3	0	1	2	0	3	0
7				0	0	2	0	1	1	0	2	3
6				0	0	2	0	1	0	0	2	1
5				0	0	1	0	0	3	0	1	3
4				0	0	1	0	0	3	0	1	1
3				0	0	1	0	0	2	0	1	1
2				0	0	0	0	0	1	0	0	3
1				0	0	0	0	0	0	0	0	1

Price of the												
Rod	20s.	0 d.		30s.	0d.		40s.	0d.		50s.	0d.	
$\frac{3}{4}$Rod	15	0		22	0		30	0		37	6	
$\frac{1}{4}$Rod	10	0		15	0		30	0		25	0	
$\frac{1}{2}$Rod	5	0		7	6		10	0		12	6	
$\frac{1}{8}$Rod	2	6		3	9		5	0		6	3	
The Price of any Number of Feet under 34 Feet or half quarter of a Rod.	s.	d.	q.	s.	d.	q	s.	d.	q.	s.	d.	q.
33	2	4	2	3	6	3	4	9	0	5	11	1
32	2	3	2	3	5	1	4	7	0	5	8	3
31	2	2	3	3	4	1	4	5	2	5	7	0
30	2	1	3	3	2	3	4	3	2	5	4	2
29	2	1	0	3	1	2	4	2	0	5	2	2
28	2	0	0	3	0	0	4	0	0	5	0	0
27	1	11	1	2	11	0	3	10	2	4	10	1
26	1	10	1	2	9	1	3	8	2	4	7	2
25	1	9	1	2	8	0	3	6	2	4	5	1
24	1	8	2	2	6	3	3	5	0	4	3	1
23	1	7	2	2	5	1	3	3	0	4	0	3
22	1	6	3	2	4	0	3	1	2	3	10	3
21	1	6	0	2	3	0	3	0	0	3	9	0
20	1	5	0	2	1	2	2	10	0	3	6	2
19	1	4	0	1	11	0	2	8	0	3	3	0
18	1	3	1	1	10	3	2	6	2	3	2	0
17	1	2	1	1	9	1	2	4	2	2	11	2
16	1	1	2	1	8	1	2	3	0	3	9	3
15	1	0	2	1	6	3	2	1	0	2	7	1
14	0	11	2	1	5	1	1	11	0	2	4	3
13	0	10	3	1	4	2	1	9	2	2	2	3
12	0	10	0	1	3	0	1	8	0	2	1	0
11	0	9	0	1	1	2	1	6	0	1	10	2
10	0	8	0	1	0	0	1	4	0	1	8	0
9	0	7	1	0	10	3	1	2	2	1	6	0
8	0	6	1	0	9	1	1	0	2	1	3	2
7	0	5	2	0	8	1	0	11	0	1	1	0
6	0	4	2	0	6	3	0	9	0	1	11	1
5	0	3	3	0	5	2	0	7	2	0	9	1
4	0	2	3	0	4	0	0	5	2	0	6	3
3	0	2	1	0	3	2	0	4	2	0	5	3
2	0	1	2	0	2	1	0	3	0	0	3	3
1	0	0	3	0	1	0	0	1	2	1	3	3

	Rod	3l. 0s. 0d.	4l. 0s. 0d.	5l. 0s. 0d.	10l. 0s. 0d.
Price of the	¼Rod	2 5 0	3 0 0	3 15 0	7 10 0
	½Rod	1 10 0	2 0 0	2 10 0	5 0 0
	¼Rod	0 15 0	1 0 0	1 5 0	2 10 0
	⅛Rod	0 7 6	0 10 0	0 12 6	1 5 0
The Price of any Number of Feet under 34 or half Quarter of a Rod.		s. d. q.	s. d. q.	s. d. q.	l. s. d. q.
	33	7 1 2	9 6 0	11 10 2	1 3 9 0
	32	6 10 2	9 2 0	11 5 2	1 2 11 0
	31	6 8 1	8 11 0	11 1 3	1 2 3 2
	30	6 5 1	8 7 0	1 8 3	1 1 5 2
	29	6 3 0	8 4 0	10 5 0	1 0 10 0
	28	6 0 0	8 0 0	10 0 0	1 0 0 0
	27	5 9 3	7 9 0	9 8 1	0 19 4 2
	26	5 6 3	7 5 0	9 3 1	0 18 6 2
	25	5 3 3	7 1 0	8 10 1	0 17 8 2
	24	5 1 2	6 10 0	8 6 2	0 17 0 0
	23	4 10 2	6 6 0	8 1 2	0 16 3 0
	22	4 0 0	6 3 0	7 9 3	0 13 7 2
	21	4 6 0	6 0 0	7 6 0	0 15 0 0
	20	4 3 0	5 8 0	7 1 0	0 14 2 0
	19	4 8 1	5 4 0	6 8 0	0 15 4 0
	18	3 9 3	5 1 0	6 4 1	0 12 8 2
	17	3 6 3	4 9 0	5 11 1	0 11 10 2
	16	3 4 2	4 6 0	5 7 2	0 11 2 0
	15	3 1 2	4 2 0	5 2 2	0 10 5 0
	14	2 10 2	3 10 0	4 9 2	0 9 6 0
	13	2 8 1	3 7 0	4 5 3	0 8 11 0
	12	2 6 0	3 4 0	4 2 0	0 8 4 0
	11	2 3 0	3 0 0	3 9 0	0 7 6 0
	10	2 0 0	2 8 0	3 4 0	0 6 8 0
	9	1 9 3	2 5 0	3 0 1	0 6 0 2
	8	1 6 3	2 1 0	2 7 1	0 5 2 2
	7	1 4 2	1 10 0	2 3 2	0 4 7 0
	6	1 1 2	1 6 0	1 10 2	0 3 8 0
	5	0 11 1	1 3 0	1 6 3	0 3 1 2
	4	0 8 1	0 11 0	1 1 3	0 2 3 2
	3	0 6 3	0 9 0	0 11 1	0 1 10 2
	2	0 4 2	0 6 0	0 7 2	0 1 3 0
	1	0 2 1	0 2 0	0 3 3	0 0 7 2

M. What is the Uſe of this Table of Rod Meaſure?

P. To readily find out the Price of any odd Feet, under $\frac{1}{4}$ of a Rod, from one Shilling to Ten Pound *per* Rod.

M. Pray explain the Table?

P. I will.

Firſt, At the Head of the Table over each Column you have the Price of one Rod, $\frac{3}{4}$ of a Rod, $\frac{1}{2}$ of a Rod, $\frac{1}{4}$ of a Rod, and half quarter of a Rod.

Secondly, In the firſt Column you have the Number of odd Feet from 1 to 34, deſcending by 33, 32, 31, *&c.* to one Foot at the Bottom, and againſt theſe odd Feet, ſtands in the other Columns the Price, or Value, as thoſe odd Feet comes to, at the Rate prefixed over each Column, the Uſe of this Table is as follows.

The Price *per* Rod agreed on being found at the Head of the Table, juſt under it you have the Price of three Quarters, the Half, the Quarter and Half Quarter, and underneath them in the ſame Columns, the Price of any Number of odd Feet, from 1 to 34, or Half Quarter of a Rod.

EXAMPLE I.

At 3 Pound the Rod, what is the Value of three Quarters, half a Rod, $\frac{1}{4}$ of a Rod, half a Quarter of a Rod, and 31 Feet.

The Price of the whole Rod	3	0	0
The Three Quarters	2	5	0
The Half Rod	1	10	0
The Quarter of a Rod	0	15	0
The Half Quarter	0	7	6
The Thirty one Feet	0	4	2^{1}
Sum	5	4	$2\frac{1}{4}$

EXAMPLE II.

At Twenty Shillings the Rod, what comes 29 Feet to?

1. Look at the Head of the Table for Twenty Shillings, (the Price of the Rod.)

2. In the firſt Column find out 29 Feet, and againſt it ſtands, 2 *s.* 1 *d.* 0 which is the Price of 29 Feet at 20 *s.* *per Rod*,

and in the like Manner you may find that

At		The Rod, that	Feet	will come to	l.	s.	d.	q.
At	10s.	The Rod, that	18	will come to	0	0	7	2
	5s.		27		0	0	5	3
	15s.		19		0	0	10	2
	20s.		8		0	0	6	1
	40s.		11		0	1	6	0
	4l.		16		0	4	6	0
	7l.		12		0	5	10	0
	10l.		10		0	6	8	0

EXAMPLE III.

At 5 *l.* 15 *s.* the Rod, what comes 31 Feet to?

In the Top of the Table you cannot find 5 *l.* 15 *s.* the Rate of the Rod given, therefore firſt find out, what 31 Feet comes to at 5 *l.* the Rod, which you will find to be 11 *s.* 1 *d.* 3 *q.* and ſecondly, find what 31 Feet comes to at 10 *s. per Rod*, which will be found to be 1 *s.* 1 *d.* 2 *q.* and laſtly, 31 Feet at 5 *s. per Rod*, comes to 6 *d.* 3 *q.* ſo that the Whole is as follows:

	s.	d.	q.
31 Feet at 5 *l.* the Rod is	11	1	3
31 Feet at 10 *s.* the Rod is	1	1	2
31 Feet at 5 *s.* the Rod is	0	6	3
Sum	12	10	0

the Value of 31 Feet, at Five Pounds and Fifteen Shillings the Rod.

EXAMPLE IV.

At Nine Pound the Rod, what comes 27 Feet to?

	s.	d.	q.
27 Feet at 5 *l.* *per* Rod is	9	8	1
27 Feet at 4 *l.* *per* Rod is	7	9	0
Sum	17	5	1

The Price of 37 Feet at Nine Pounds *per* Rod.

EXAMPLE V.

At Six Pound Seventeen Shillings and Six Pence the Rod, what comes 30 Feet to?

	s.	*d.*	*q.*
30 Feet at 5 *l.* *per* Rod	10	8	3
30 Feet at 1 *l.* *per* Rod	2	1	3
30 Feet at 10 *s.* *per* Rod	1	1	0
30 Feet at 5 *s.* *per* Rod	0	6	2
30 Feet at 2 *s.* 6 *d.* *per* Rod	0	3	1
Sum	14	9	1

The Price of 30 Feet at 6 *l.* 17 *s.* 6 *d.* *per Rod.*

M. I underſtand the Uſe of this Table very well, and find that it will be of great Service to me in making of Computations, I ſhould be very glad if you would calculate a Table exhibiting the Price of odd Feet, contained in a Square by which Roofing, Flooring, Partitioning and Tiling are meaſured.

P. Such a Table I have already calculated, which ſhall immediately follow:

A Table *exhibiting the Price or Value of any Number of odd Feet of Tiling, Slating, Roof-fing, Flooring,* &c. *performed by the Square of ten Feet, from one Foot, to twenty five, or ¼ of a Square, and at any Price from* 2s. 6d. *to* 5 *or* 10 *l. the Square ready caſt up.*

The Price of any Number of Feet under 25 Feet or ¼ of a Square.

Price of the Square	5*s.* 0*d.*	6*s.* 0*d.*	7*s.* 0*d.*	8*s.* 0*d.*
¾ Square	3 9	4 6	5 3	6 0
½ Square	2 6	3 0	3 6	4 0
¼ Square	1 3	1 6	1 9	2 0
	s. d. q.	*s. d. q.*	*s. d. q.*	*s. d. q.*
24	1 2 1	1 5 1	1 7 3	1 11 0
23	1 1 3	1 4 2	1 6 2	1 10 1
22	1 1 0	1 2 3	1 5 3	1 9 0
21	1 0 3	1 3 0	1 5 0	1 8 1
20	1 0 0	1 2 1	1 4 1	1 7 0
19	0 11 2	1 1 2	1 3 2	1 6 1
18	0 10 3	1 0 3	1 2 2	1 5 0
17	0 10 1	1 0 0	1 1 3	1 4 1
16	0 9 2	0 11 1	1 1 0	1 3 0
15	0 9 0	0 10 2	1 0 0	1 2 1
14	0 8 2	0 9 3	0 11 1	1 1 2
13	0 7 3	0 9 0	0 10 2	1 0 1
12	0 7 1	0 8 1	0 9 3	0 11 2
11	0 6 3	0 7 2	0 9 0	0 10 2
10	0 6 0	0 6 3	0 8 1	0 9 2
9	0 5 2	0 6 0	0 7 1	0 8 3
8	0 4 3	0 5 1	0 6 2	0 7 3
7	0 4 0	0 4 2	0 5 3	0 6 3
6	0 3 3	0 3 3	0 5 0	0 5 3
5	0 3 0	0 3 0	0 4 0	0 4 3
4	0 2 1	0 2 1	0 3 1	0 3 3
3	0 1 3	0 1 3	0 2 2	0 3 0
2	0 1 1	0 1 0	0 1 3	0 2 0
1	0 0 3	0 0 2	0 0 3	0 1 0

Price of the Square	9s. 0d.	10s. 0d.	11s. 0d.	12s. d.
¾Square	6 9	7 6	8 3	9 0
½Square	4 6	5 0	5 6	6 0
¼Square	2 3	2 6	2 9	3 0
The Price of any Number of Feet under 25 or ¼ Square.	s. d. q.	s. d. q.	s. d. q.	s. d. q.
24	2 1 0	2 4 3	2 7 2	2 10 2
23	2 0 3	2 3 2	2 6 1	2 9 0
22	1 11 3	2 2 1	2 4 3	1 7 2
21	1 10 3	2 1 1	2 3 3	1 6 0
20	1 9 2	2 0 0	2 2 1	1 4 2
19	1 8 2	1 10 3	2 1 0	1 3 0
18	1 7 2	1 9 2	1 11 2	1 1 2
17	1 6 1	1 8 1	1 10 1	1 1 0
16	1 5 1	1 7 1	1 8 3	1 10 2
15	1 4 0	1 6 0	1 7 2	1 9 0
14	1 3 0	1 4 3	1 6 1	1 7 2
13	1 2 2	1 3 2	1 4 3	1 6 0
12	1 1 0	1 2 1	1 3 2	1 4 2
11	1 0 0	1 1 1	1 2 1	1 3 0
10	0 10 3	1 0 0	1 0 3	1 1 2
9	0 9 3	0 10 3	0 11 2	1 0 0
8	0 8 3	0 9 2	0 10 2	0 10 2
7	0 7 2	0 8 1	0 8 2	0 9 0
6	0 6 2	0 7 1	0 7 2	0 7 2
5	0 5 2	0 6 0	0 6 0	0 6 0
4	0 4 1	0 4 3	0 4 2	0 4 2
3	0 3 1	0 3 2	0 3 2	0 2 2
2	0 2 1	0 2 1	0 2 1	0 2 0
1	0 1 0	0 1 2	0 1 2	0 1 2

Price of the	Square	13s. d.	14s. d.	20s. d.	30s. d.	2l. s. d.
	¾Square	9 9	10 6	15 0	22 6	1 10 0
	½Square	6 6	7 0	10 0	15 0	1 0 0
	¼Square	3 3	3 6	5 0	7 6	0 10 0
The Price of any Number of Feet under 25 or ¼ of a Square.		s. d. q.	s. d. q.	s. d. q.	l. s. q.	s. d. q.
	24	3 1 1	3 3 2	4 9 2	7 2 1	9 7 0
	23	3 0 0	3 1 0	4 7 1	6 10 3	9 2 2
	22	2 10 0	2 11 2	4 4 3	6 6 0	8 9 2
	21	2 9 0	2 10 0	4 2 2	6 3 3	8 5 0
	20	2 7 0	2 8 2	4 0 0	6 0 0	8 0 0
	19	2 5 3	2 7 0	3 9 2	5 8 1	7 7 0
	18	1 3 3	2 5 0	3 7 1	5 4 3	7 2 2
	17	1 2 2	2 3 2	3 4 3	5 1 0	6 9 2
	16	1 0 2	2 2 0	3 2 2	4 9 3	6 5 0
	15	1 11 1	2 0 0	3 0 0	4 6 0	6 0 0
	14	1 10 0	1 0 2	2 9 2	4 2 1	6 7 0
	13	1 8 0	1 9 0	2 7 1	3 10 3	5 2 2
	12	1 6 3	1 7 2	2 4 3	3 7 0	4 9 2
	11	1 5 2	1 6 0	2 2 2	3 3 3	4 5 0
	10	1 3 2	1 4 2	2 0 0	3 0 0	4 0 0
	9	1 2 1	1 2 2	1 9 2	2 8 1	3 7 0
	8	1 0 2	1 1 0	1 7 1	2 4 3	3 2 2
	7	0 10 3	0 11 2	1 4 3	2 1 0	2 9 2
	6	0 8 2	0 10 0	1 2 2	1 9 3	2 5 0
	5	0 7 3	0 8 0	1 0 0	1 6 0	2 0 0
	4	0 5 2	0 6 2	0 9 2	1 2 1	1 7 0
	3	0 4 3	0 5 0	0 7 1	0 10 3	1 2 2
	2	0 3 1	0 3 2	0 4 3	0 7 0	0 9 2
	1	0 1 3	0 1 2	0 2 2	0 3 1	0 5 0

M. Pray explain to me the Uſe of this Table.

P. I will.

Firſt, (As in the former) at the Head of the Table you have the Price of one Square, three Quarters of a Square, one Half of a Square, and one Quarter of a Square placed over each Column, calculated from Five Shillings the Square, to Forty Shillings the Square, and by Addition to Five Pound, Ten Pound, *&c. per* Square, as will appear hereafter.

Secondly, In the firſt Column you have any Number of odd Feet under 25, and in the other Columns, is placed the Price or Rate as any Number of odd Feet under 25 comes to, according to the Rate or Price at the Head of the Column.

The Uſe of the Table follows.

The Price agreed on, being found at the Head of the Table, underneath it you have the Price of three Quarters of a Square, Half a Square, and one Quarter of a Square, and againſt the odd Feet their reſpective Prices.

I will illuſtrate the Uſe by Examples.

EXAMPLE I.

At Twelve Shillings the Square, what is the Price of three Quarters of a Square, Half of a Square, one Quarter of a Square and 20 Feet

	l.	*s.*	*d.*	*q.*
The Square is at	0	12	0	0
The 3 Quarters is	0	9	0	0
The Half	0	6	0	0
The Quarter	0	3	0	0
The 20 Feet	0	1	4	2
Sum	0	19	4	2

EXAMPLE II.

At 13 *s.* the Square, what comes 24 Feet to?

Againſt 24 Feet in the firſt Column, and under 13 *s.* at the Head of the Table, ſtands 3 *s.* 1 *d.* $\frac{1}{4}$, which is the Price or Value of 24 Feet, at 13 *s. per* Square.

And after the ſame Manner you may find that

At	s.	The Square, that		will come to,	l.	s.	d.	q.
	5		21		0	1	0	3
	7		17		0	1	1	3
	9		11		0	1	0	0
	11		9		0	0	11	2
	13		16		0	1	0	2
	20		20		0	4	0	0
	40		21		0	8	5	0

And the like for any other Rate under 25 Feet or $\frac{1}{4}$ of a Square.

EXAMPLE III.

At One Pound Sixteen Shillings the Square, what comes 22 Feet to?

In the upper Part of the Table, you cannot find Thirty Six Shillings, the Rate given, but you may find Thirty Shillings in one Column, and Six Shillings in another;

	s.	d.	q.
22 Foot at 30 *s.* is	6	6	0
and 22 Foot at 6 *s.* is	1	3	0
So that 22 Feet at 36 *s. per* Square comes to	7	9	3

EXAMPLE IV.

At 2 *l.* 12 *s.* the Square, what comes 21 Feet to?

	s.	*d.*	*q.*
21 Feet at 40 *s.* the Square is	8	5	0
21 Feet at 12 *s.* the Square is	1	6	0
21 Feet at 52 *s.* the Square is	9	11	0

EXAMPLE V.

At 3 *l.* 12 *s.* the Square what comes 12 Feet to?

	s.	*d.*	*q.*
12 Foot at 40 *s.* the Square is	4	9	2
12 Foot at 30 *s.* the Square is	3	7	0
12 Foot at 9 *s.* the Square is	1	1	0
12 Feet at 3 *l.* 19 *s.* 10 *d.* is	9	5	2

EXAMPLE VI.

At 2*l.* 12*s.* and 6*d.* *per* Square, what doth 24 Feet come to?

	s.	*d.*	*q.*
24 Feet at 40 *s.* is	9	7	0
24 Feet at 10 *s.* is	2	4	3
24 Feet at 5 *s.* is 1 *s.* 2 *d.* 1 whoſe half is —— ——	7	7	$\frac{1}{2}$
24 Feet at 2 *l.* 12 *s.* 6 *d.* is	12	6	3$\frac{1}{2}$

and the like for any other Rate required.

M. I wonderfully approve of theſe Tables, pray have you any other by you?

P. Yes, I have divers others, but for the preſent, I ſhall inſert but two more, the one ſhewing the Value of odd Feet in the Yard-Meaſure, and the other a Table reducing the Thickneſs of any Brick Wall, to the Standard Thickneſs of one Brick and half.

An inſpectional Table, exhibiting what any Number of odd Feet in a Superficial or Solid Yard, comes unto; for any Price by the Yard from One *Farthing* per *Yard to Ten Pound*, &c.

Superficial Feet			1			2			3		
			s.	*d.*	*q.pts.*	*s.*	*d.*	*q.pts.*	*s.*	*d.*	*q.pts.*
The Price of the Yard in	Farthings	1	0	0	0,11	0	0	0,22	0	0	0,33
		2	0	0	0,22	0	0	0,44	0	0	0,67
		3	0	0	0,33	0	0	0,66	0	0	1,00
	Pence	1	0	0	0,44	0	0	0,89	0	0	1,33
		2	0	0	0,89	0	0	1,78	0	0	2,66
		3	0	0	1,33	0	0	2,67	0	1	0,00
		4	0	0	1,77	0	0	3,54	0	1	1,33
		5	0	0	2,22	0	1	1,43	0	1	2,66
		6	0	0	2,66	0	1	2,32	0	2	0,00
		7	0	0	3,10	0	1	3,21	0	2	1,33
		8	0	0	3,55	0	2	0,10	0	2	2,66
		9	0	1	0,00	0	2	0,99	0	3	0,00
		10	0	1	0.44	0	2	1,88	0	3	1,00
		11	0	1	0.89	0	2	2,77	0	3	2,66
	Shillings	1	0	1	1,33	0	2	2,66	0	4	0,00
		2	0	2	2,66	0	5	1,33	0	8	0,00
		3	0	4	0,00	0	8	0,18	1	0	0,00
		4	0	5	1,33	0	10	2,66	1	4	0,00
		5	0	6	2,66	1	11	1,33	1	8	0,00
		6	0	8	0,00	1	14	0,00	2	0	0,00
		7	0	9	1,33	1	6	2,66	2	4	0,00
		8	0	10	2,66	1	9	1,33	2	8	0,00
		9	1	0	0,00	2	10	0,00	3	0	0,00
		10	1	1	1,33	2	12	2,66	3	4	0,00
	Pounds	1	2	2	2,67	4	5	1,33	6	8	0,00
		2	4	5	1.33	8	10	2,67	13	4	0,00
		3	6	8	0,00	13	4	0,00	20	0	0,00
		4	9	10	2,67	17	9	1,33	26	8	0,00
		5	12	1	1,33	23	2	2,67	33	4	0.00
Solid Feet			3			6			9		

An Inſpectional Table, exhibiting what any Number of odd Feet in a Superficial or Solid Yard comes unto; for any Price by the Yard, from One Farthing per *Yard to Ten Pound, &c.*

Superficial Feet			4			5			6		
			s.	*d.*	*q.pts.*	*s.*	*d.*	*q.pss.*	*s.*	*d.*	*q.pts.*
The Price of the Yard in	Farthings	1	0	0	0,44	0	0	0,55	0	0	0,67
		2	0	0	0,88	0	0	1,10	0	0	1,33
		3	0	0	0,33	0	0	1,65	0	0	2,00
	Pence	1	0	0	1,77	0	0	2,22	0	0	2,66
		2	0	0	3,54	0	1	0,44	0	1	1,32
		3	0	1	1,32	0	1	2,68	0	2	0,00
		4	0	1	3,10	0	2	0,88	0	2	2,66
		5	0	2	0,87	0	2	3,10	0	3	1,33
		6	0	2	2,64	0	3	1,32	0	4	0,00
		7	0	2	0,42	0	3	3,54	0	4	2,66
		8	0	3	2,20	0	4	1,76	0	5	1,33
		9	0	3	0,98	0	4	3,98	0	6	0,00
		10	0	4	1,76	0	5	2,20	0	6	2,66
		11	0	4	3,53	0	6	0,42	0	7	1,33
	Shillings	1	0	5	1,33	0	6	2,66	0	8	0,00
		2	0	10	2,66	1	1	1,33	1	4	0,00
		3	1	4	0,00	1	8	0,00	2	0	0,00
		4	1	9	1,33	2	2	2,66	2	8	0,00
		5	2	2	2,66	2	9	1,33	3	4	0,00
		6	2	8	0,00	3	4	0,00	4	0	0,00
		7	3	1	1,33	3	10	2,66	4	8	0,00
		8	3	6	2,66	3	5	1,33	5	4	0,00
		9	4	0	0,00	5	0	0,00	6	0	0,00
		10	4	5	1,33	5	6	2,66	6	8	0,00
	Pounds	1	8	10	2,67	11	1	1,33	13	4	0,00
		2	17	9	1,33	22	2	2,67	26	8	0,00
		3	26	8	0,00	33	4	0,00	40	0	0,00
		4	35	6	2,67	44	5	1,33	53	4	0,00
		5	44	5	1,33	55	6	2,67	66	8	0,00
	Feet Solid		12			15			18		

An Inſpection Table, exhibiting what any number of odd Feet in a ſuperficial or Solid Yard, comes unto; for any Price by the Yard from One Farthing per *Yard to Ten Pound,* &c.

Feet Superſicial		7			8			A Yard		
		s.	*d.*	*q.pts.*	*s.*	*d.*	*q.pts.*	*s.*	*d.*	*q.pts*
Farthings	1	0	0	0 77	0	0	0,88	0	0	1,00
	2	0	0	1,54	0	0	1,76	0	0	2,00
	3	0	0	2,31	0	0	2,66	0	0	3,00
Pence	1	0	0	3.10	0	0	3,55	0	1	0,00
	2	0	1	2,20	0	1	3,10	0	2	0,00
	3	0	2	1,30	0	2	2,65	0	3	0,00
	4	0	3	0,40	0	3	2,20	0	4	0,00
	5	0	3	3,50	0	4	1,75	0	5	0,00
	6	0	4	2,60	0	5	1,30	0	6	0,00
	7	0	5	1,70	0	6	0,85	0	7	0,00
	8	0	6	0,80	0	7	0,40	0	8	0,00
	9	0	6	3,90	0	8	0,95	0	9	0,00
	10	0	7	3,00	0	9	0,50	0	10	0,00
	11	0	8	2,10	0	10	0,05	0	11	0,00
Shillings	1	0	6	1,33	0	10	2,66	1	0	0,00
	2	1	9	2,67	1	9	1,33	2	0	0,00
	3	2	4	0,00	2	8	0,00	3	0	0,00
	4	3	1	1,33	3	6	2,67	4	0	0,00
	5	3	10	2,67	4	5	1,33	5	0	0,00
	6	4	8	0,00	5	4	0,00	6	0	0,00
	7	5	5	1,33	6	2	2,67	7	0	0,00
	8	6	2	2,67	7	1	1,33	8	0	0,00
	9	7	0	0,00	8	0	0,00	9	0	0,00
	10	7	9	1,33	8	10	2,66	10	0	0,00
Pounds	1	15	6	2,67	17	9	1,33	20	0	0,00
	2	31	1	1,33	35	6	2,67	40	0	0,00
	3	46	8	0,00	53	4	0,00	60	0	0,00
	4	62	2	2,67	71	1	1,33	80	0	0,00
	5	77	6	1,33	88	10	2,66	100	0	0,00
Feet Solid		21			24			A Yard Cubical		

M. The Uſe of this Table doth not appear to be ſo plain as the preceeding.

P. Yes it is, as you ſhall find by the Explanation and Uſe.

Firſt, At the Head of the Table are the odd Feet contained in a Yard Superficial, beginning at one Foot, and ending at a Yard.

At the Bottom of the Table you have the number of Feet in a Cubical Yard, numbred by 3, 6, 9, *&c.* to a Yard Solid.

In the firſt Column towards the Left-Hand, is placed the Price of a Yard from one Farthing to 5 *l. per* Yard, and in the other Columns under the odd Feet, is placed the Price in Shillings, Pence, Farthings, and Hundred Parts of a Farthing, as any Number of odd Feet comes to.

The Uſe of this ſhall be made plain by Examples.

EXAMPLE I.

At Eight Pence the Yard, what comes 6 Feet to?

Look for 8 Pence in the firſt Column, and under 6 Feet in the Angle of meeting you find 0*s.* 5 *d.* 1 *q.* 33, that is 00 *s.* 5 *d.* 1 Farthing, and 33 Hundred Parts of a Farthing, which is the Price or Value of 6 Feet, at 8 Pence the Yard, Superficial, and in like Manner, may be found that at

3 Farthings	The Yard, that	7	Foot will come to,	0 : 0 : 2,31
3 Pence		5		0 : 1 : 2,66
9 Pence		4		0 : 3 : 0,98
7 Shillings		6		4 : 8 : 0,00
4 Pound		8		71 : 1 : 1,33

And the like of any other.

EXAMPLE II.

At 5 Shillings and 4 Pence Half-penny *per* Yard, what comes 8 Foot to?

	s.	*d.*	*qpts.*
8 Foot at 5 Shillings is	4 :	5 :	1,33
8 Foot at 4 Pence is	0 :	3 :	2,20
8 Foot at Half Penny is	0 :	0 :	1,76
So that 8 Feet, at 5 Shillings 4 Pence 2 *q.* *per* Yard is,	4 :	9 :	1,29

EXAMPLE III.

At Three Pounds Seven Shillings Nine Pence Half-penny the Yard, what comes 7 Foot ½ to?

	l.	*s.*	*d.*	*q.*
7 Feet at 3 *l.* *per* Yard is ——	2	6	8	0
Half a Foot at 3 *l.* *per* Yard is ——	0	3	4	0
7 Feet at 7 *s.* *per* Yard is — —	0	05	5	1,33
Half a Foot at 7 *s.* *per* Yard is ——	0	0	4	2
7 Feet at 9 *d.* *per* Yard is ——	0	0	6	3,90
7 Feet at Half-penny *per* Yard is	0	0	0	1,54
Half a Foot at ½ Penny *per* Yard is	0	0	0	0,11
7 Feet at 3*l.* 7*s.* 9 *d.* 2 *q.* the Yard comes to ——	2	16	5	2,88

EXAMPLE IV.

At 2*s.* and 7*d.* the Cubical Yard, what comes 18 Feet to?

Find 18 at the Bottom of the Table, and 2 *s.* in the firſt Column, and in the Angle of meeting, ſtands 1 *s.* 4*d.* 0,00*q.pts.* likewiſe againſt 7 *d.* and over 18 in the Angle of meeting you find 0*s.* 4*d.* 2,66*q. pts.* which added to the other makes 1 *s.* 8*d.* 2*q.* 66, which is the Price of 18 Feet at 2*s.* 7*d.* *per* Yard ſolid.

EXAMPLE V.

At 12*s.* 5*d.* 2*q.* the Yard Cubical, what comes 20 Feet to?

Firſt, Becauſe we cannot find 20 at the Bottom of the Table take it at twice, *viz.* at 18, and ⅔ of three.

	l.	*s.*	*d.*
18 Feet at 10*s.* the yard comes to —	6	8	0
18 Feet at 2 *s.* the yard is	1	4	0
18 Feet at 5 *d.* the yard is	0	3	1,33
18 Feet at Half-Penny *per* yard is	0	0	1,33
2 Feet at 10 *s.* the yard is ⅔ of 3 Feet	0	8	2 almoſt
2 Feet at 2 *s.* the yard is ⅔ of 3 Feet	1	4	0
2 Feet at 5*d.* the yard is ⅔ of 3 Feet	0	0	0,73
2 Feet at 2*q.* *per* yard ⅔ is	0	0	0,14
The Price of 20 Feet at 12*s.* 5*d.* 2*q.* the yard Cubical	10	4	1,53

An

An Inſpectional Table, reducing Brickwork of any Thickneſs, to the Standard Thickneſs of one Brick and Half.

		½ Brick			1 Brick			1½ Brick.			2 Bricks.		
		R.	*Q.*	*F.*	*R.*	*Q.*	*F.*	*R.*	*Q.*	*F.*	*R.*	*Q.*	*F.*
	1 Quarter	0	0	22	0	0	45	0	1	0	0	1	22
	2 Quarter	0	0	45	0	1	22	0	2	0	0	2	45
	3 Quarter	0	1	00	0	2	00	0	3	0	1	0	00
Rods contained upon the Superficial Measure of the Wall.	1	0	1	22	0	2	45	1	0	0	1	0	22
	2	0	2	45	1	1	22	2	0	0	2	2	45
	3	1	0	00	2	0	00	3	0	0	4	0	00
	4	1	1	22	2	2	45	4	0	0	5	1	22
	5	1	2	45	3	1	22	5	0	0	6	2	45
	6	2	0	00	4	0	00	6	0	0	8	0	00
	7	2	1	22	4	2	45	7	0	0	9	1	22
	8	2	2	45	5	1	22	8	0	0	10	2	45
	9	3	0	00	6	0	00	9	0	0	12	0	00
	10	3	1	22	6	2	45	10	0	0	13	1	22
	11	3	2	45	7	1	22	11	0	0	14	2	44
	12	4	0	00	8	0	00	12	0	0	16	0	00
	13	4	1	22	8	2	45	13	0	0	17	1	22
	14	4	2	45	9	1	22	14	0	0	18	2	45
	15	5	0	00	10	0	00	15	0	0	20	0	00
	16	5	1	22	10	2	45	16	0	0	21	1	22
	17	5	2	45	11	1	22	17	0	0	22	2	45
	18	6	0	00	12	0	00	18	0	0	24	0	00
	19	6	1	22	12	2	45	19	0	0	25	1	22
	20	6	2	45	13	1	22	20	0	0	27	2	45
	21	7	0	00	14	0	00	21	0	0	28	0	00

An Inſpectional Table, reducing Brickwork of any Thickneſs, to the Standard Thickneſs of one Brick and Half.

		2½ Bricks			3 Bricks			3½ Bricks			4 Bricks.		
		R.	*Q.*	*F.*	*R.*	*Q.*	*F.*	*R.*	*Q.*	*F.*	*R.*	*Q.*	*F.*
	1 Quarter	0	1	45	0	2	0	0	2	22	0	2	45
	2 Quarter	1	3	22	1	0	0	1	0	45	1	1	22
	3 Quarter	1	1	00	1	2	0	1	3	00	2	0	00
Rods contained upon the Superficial Meaſure of the Wall.	1	1	2	45	2	0	0	2	1	22	2	2	45
	2	3	1	22	4	0	0	4	2	45	5	1	22
	3	5	0	00	6	0	0	7	0	00	8	0	00
	4	6	2	45	8	0	0	9	1	22	10	2	45
	5	8	1	22	10	0	0	11	2	45	12	1	22
	6	11	0	00	11	0	0	14	0	00	16	0	00
	7	11	2	45	14	0	0	16	1	22	18	2	45
	8	13	1	22	16	0	0	18	2	45	21	1	22
	9	15	0	00	18	0	0	21	0	00	24	0	00
	10	16	2	45	20	0	0	23	1	22	26	2	45
	11	18	1	22	22	0	0	25	2	45	29	1	22
	12	20	0	00	24	0	0	28	0	00	32	0	00
	13	21	2	45	26	0	0	30	1	22	34	2	45
	14	23	1	22	28	0	0	32	2	45	37	1	22
	15	25	0	00	30	0	0	35	0	00	40	0	00
	16	26	2	45	32	0	0	37	1	22	42	2	45
	17	28	1	22	34	0	0	39	2	45	45	1	22
	18	30	0	00	30	0	0	42	0	00	48	0	00
	19	31	2	45	38	0	0	44	1	22	50	2	45
	20	33	1	22	40	0	0	46	2	45	53	1	22
	21	35	0	00	42	0	0	49	0	00	56	0	00

An Inſpectional Table, reducing Brickwork of any Thickneſs to the Standard Thickneſs of one Brick and Half.

Rods contained upon the Superficial Measure of the Wall.	4½ Bricks			5 Bricks			5½ Bricks		
	R.	*Q.*	*F.*	*R.*	*Q.*	*F.*	*R.*	*Q.*	*F.*
1 Quarter	0	3	0	0	3	22	0	34	45
2 Quarter	1	2	0	1	2	45	1	3	22
3 Quarter	2	1	0	2	2	00	2	3	00
1	3	0	0	3	1	22	3	2	45
2	6	0	0	6	2	45	7	1	22
3	9	0	0	10	0	00	11	0	00
4	12	0	0	13	1	22	14	2	45
5	15	0	0	16	2	45	18	1	22
6	18	0	0	20	0	00	22	0	00
7	21	0	0	23	1	22	25	2	45
8	24	0	0	26	2	45	29	1	22
9	27	0	0	30	0	00	33	0	00
10	30	0	0	33	1	22	36	2	45
11	33	0	0	36	2	45	40	1	22
12	36	0	0	40	0	00	44	0	00
13	39	0	0	43	1	22	47	2	45
14	42	0	0	46	2	45	51	1	22
15	45	0	0	50	0	00	55	0	00
16	48	0	0	53	1	22	58	2	45
17	51	0	0	56	2	45	62	1	22
18	54	0	0	60	0	00	66	0	00
19	57	0	0	63	1	22	69	2	45
20	60	0	0	66	2	45	73	1	22
21	63	0	0	70	0	00	77	0	00

M. Pray explain this Table to me.

P. In the head of the Table is placed the Thickneſs of the Wall in Bricks and half Bricks from half a Brick in Thickneſs to ſix Bricks Thick: In the firſt Column is placed the number of Rods, contained in any Wall, from $\frac{1}{4}$ of a Rod to 21 Rod, and againſt thoſe Numbers, in the other Columns, ſtands the quantity of Brickwork in Rods, Quarters and Feet, as the Wall contains, at any of thoſe Thickneſſes at the Head of the Table; a few Examples will make it plain.

EXAMPLE I.

Suppoſe a Wall upon the Superficies contain Ten Rod, and its Thickneſs be three Bricks and Half; how many Rod is in that Wall at the Standard Thickneſs of one Brick $\frac{1}{2}$?

Find 10 Rod in the firſt Column, and under 3$\frac{1}{2}$ Bricks at the Head of the Table, in the Angle of Meeting is 23, 1, 22. which is 23 Rod, 1 Quarter and 22 Feet, which is the true quantity required at the Standard Thickneſs of 1$\frac{1}{2}$ Brick Thick.

And in the like manner by the Table you may find, that if the Superficial Content of a Wall be 15 Rod; if that Wall be in Thickneſs.

		r.	q.	f.	
	Brick, it will contain being reduced to the Standard Thickneſs of one Brick and half	5	0	0	Contents requir'd.
1		10	0	0	
$1\frac{1}{2}$		15	0	0	
2		20	0	0	
$2\frac{1}{2}$		25	0	0	
3		30	0	0	
$3\frac{1}{2}$		35	0	0	
4		40	0	0	
$4\frac{1}{2}$		45	0	0	
5		50	0	0	

EXAMPLE II.

If a Wall be 4 *Bricks* $\frac{1}{2}$ *thick, and contain upon the Superficies* 20 *Rod, how many Rod of Brickwork is in that Wall at the Standard Thickneſs.*

Find 20 in the firſt Column, and under $4\frac{1}{2}$ Bricks ſtands 60*r.* 00*q.* 00*f.* which is 60 Rod, 00 Quarters, 00 Feet, the Contetnt requir'd and in like manner if a Wall.

			Brick		r.	q.	f.
Contain	21	Rod upon the Superficies	$3\frac{1}{2}$	Thick it will contain being reduced	28	0	00
	16		$2\frac{1}{2}$		26	2	45
	21		5		70	0	00

EXAMPLE III.

There is a Wall whoſe Superficies meaſures 12 *Rod* 3 *Quarters, and is* 4 *Brick thick, how many Rod of Work, is in that Wall at Standard Thickneſs*

	r.	q.	f.
12 Rod at 4 Bricks Thick is	32	0	0
3 Quarters at 4 Brick is	02	0	0
So that the Wall contains	34	0	0

EXAMPLE IV.

The Superficial Content of a Wall is 10 *Rod, and* 9½ *Bricks thick, how many Rod of Work is in that Wall?*

Becauſe the Table do not extend to 9½ Bricks at the Head, therefore take it at twice.

10 Rod at 5 Brick thick is	33	1	22
10 Rod at 4½ Brick Thick is	30	0	00
10 Rod at 9½ Brick Thick is	63	1	22

And thus much for the Uſe of the Tables.

I ſhall now proceed to demonſtrate unto you the Proportions, that all ſorts of Rooms in a Building ought to bear one to another, in regard to their Length, Breadth, and Height, as alſo of Gates, Doors, Windows, Chimneys, Stairs and Stair-Caſes, and then conclude for the preſent.

Of GALLERIES.

M. What Proportion ſhould the length of a Gallery have to its breadth?

P. Not leſs than five Times its Breadth, nor more than eight.

M. What Height ought Galleries to have?

P. Their Height ought to be equal to their Breadth.

M. What is the beſt Aſpect for Galleries?

P. The North, becauſe its light is beſt for Paintings, &c. which they are generally adorn'd with.

M. Is it not poſſible to make Galleries too Narrow or too Wide?

P. Yes, and therefore their Breadth ſhould never be Leſs than ſixteen Feet, nor to exceed twenty four Feet.

Of HALLS.

M. What is to be Obſerved in the Proportion of Halls?

P. That their Length be not leſs than twice their Breadth, nor to exceed three imes.

M. Of what height muſt Halls be?

P. If their Ceilings are flat, their Height may be two Thirds of their breadth, and if the Ceiling be arched, the Height may be $\frac{5}{6}$ of its Breadth.

Of CHAMBERS.

M. What Situation is beſt for Chambers of Delight?

P. The *Eaſt*, provided that any other hath not a better Proſpect.

M. What Proportion ought a good Lodging-Chamber to have?

P. That its Length be never more than its Breadth and half Breadth, nor leſs than the Breadth its ſelf, *viz.* exactly ſquare.

M. Of what Height ought Chambers to be?

P. The Height of Chambers of the firſt

Story, not leſs than $\frac{2}{3}$ of their Breadth, the ſecond Story $\frac{11}{12}$ of the firſt, and the third Story $\frac{3}{4}$ of the ſecond.

Of INNER-DOORS.

M. Of what Breadth may Doors be made in large Buildings?

P. Doors in large Buildings muſt be always in proportion to the Place wherein they ſtand, their Breadth muſt not be leſs than three Feet, nor more than ſix Feet, and their Height always equal (at leaſt) to double their Breadth, or two Diameters: Inner-Doors in ſmall Buildings muſt never be leſs than two Feet and half in Breadth and in Height ſix Feet. As *Palladio* obſerves; but he means an Italian Foot about 14 Inches of Engliſh Meaſure.

Of WINDOWS.

M. What are the principal Things to be obſerv'd in Windows?

P. Firſt, Their Magnitude.

Secondly, their Number: And,

Thirdly, The bigneſs of the Room, that they are to enlighten; for its poſſible to make Rooms as well too light, as too dark. The Height of Windows of the firſt Story, may be two Diameters, and where neceſſary, two Diameters and $\frac{1}{4}$, $\frac{1}{3}$, or $\frac{1}{2}$. The Height of Windows in the ſecond and third Stories to be in the ſame Proportion as that of Chambers.

Of the Placing of DOORS *and* WINDOWS.

Firſt, Let all the Doors (if poſſible) be placed right oppoſite againſt one another, ſo that a clear View may be had throughout the whole Houſe, which is both graceful and convenient.

Secondly, Place your Windows in ſuch Order that thoſe on the right of the Door be equal to thoſe on the left, and thoſe in the Stories above, to be directly over thoſe below.

Thirdly, 'Tis of great Service as well as Ornament, to turn Arches over Doors and Windows, to diſcharge the Weight as lies over them.

Laſtly, Suffer not Windows to be placed too near the Angles of a Building, but leave the Coyn as large as may be with Conveniency, for thoſe Coyns are the very Nerves and Support of the whole Building.

Of CHIMNIES.

The ſeveral Sorts of Chimnies, are thoſe of the Hall, the Parlour, the Chamber, the Study, and Kitchen.

Firſt, Hall Chimnies, ought to be in the Clear between Jaum and Jaum, 5 Feet, and in large Buildings 6 Feet. The Height of the Mantle-tree to be about 4½ Feet, and the Projecture of the Jaums about 2 Feet 6 Inches, or leſs.

Secondly, Parlour or Chamber Chimnies, not to exceed 5 Feet between Jaum and Jaum, their Height to be about 4 Feet and Projecture 2 Feet or thereabout.

Thirdly, Chimnies in Studies, &c. their Breadth to be 4 Feet at moſt, Height 3½ Feet, and Depth of the Jaums 1 Foot, 9 Inches.

Of the FUNNELS *of* CHIMNIES.

The Funnels of Chimneys muſt be carried through the Roof at leaſt 5 or 6 Feet, otherwiſe the Wind will repulſe the Smoak. Funnels of Chimneys ſhould not be too Wide nor too Narrow, if too Wide, the Wind will drive back the Smoak, and if too Narrow, the Smoak is repulſed by the Wind and beaten back alſo. Therefore great Chimneys may be made about 14 or 15 Inches Square, and for Chamber Chimneys, *&c.* about 1 Foot Square, or ſcarce ſo much.

Of STAIR-CASES.

Great care ought to be taken in the placing of the Stair-Caſe of any Building, but commonly the Stairs are placed in the Angle, Wing or middle of the Front.

To every Stair-Caſe, are required three Openings.

Firſt, The Door leading to them.

Secondly, The Window or Windows as gives Light to them. And

Thirdly, Their Landing.

Firſt, The Door leading to a Stair-caſe, ſhould be ſo placed that moſt of the Building may be ſeen before you come at the Stairs, and in ſuch a Manner, that it may be eaſy for any Perſon to find out.

Secondly, For the Windows, if there is but one, it muſt be plac'd in the Middle of the Stair-caſe, that thereby the whole may be enlightned; but if more than one Window, place one in each Story.

Thirdly, The Landing of Stairs, ſhould be large and ſpacious for the convenient Entrance into the Rooms: In a word, Stair-caſes ſhould be ſpacious, light and eaſy in Aſcent. The Height of large Steps muſt never be leſs than 6 Inches, nor more than 7 Inches and half.

The Breadth of Steps ſhould be never leſs than 10 Inches, nor more than 15 Inches.

In making of Stair-caſes this Rule ſhould be obſerved, that the Number of Steps at every Landing be odd, and not even, for thereby, when you begin to aſcend with your right Foot firſt (as all Perſons generally do) you will end with the ſame Foot alſo.

M. Sir, I am very much obliged to you, pray inform me what Arts in general I ought to be well qualified with, ſo as to be a complete Architect.

P. Beſides the Proportions that I have here demonſtrated, which you are now well acquainted with, and what ought to be firſt read, and well underſtood by every young Student; there are many others, of very great Uſe and Beauty, that abſolutely depend upon *Arithmetick*, *Geometry*, *Plain Trigonometry*, &c. And when ever you meet with any Part that at firſt Reading appears any Thing difficult, paſs it over, and proceed to the next, and ſo on till you have gone through the ſeveral Operations, at leaſt ſix Times, during which all thoſe Parts that at firſt View appeared difficult, will become familiar and eaſy.

M. I thank you, Sir, pray inform me what Inſtruments are proper for my Purpoſe?

P. The Inſtruments proper for your Purpoſe are, firſt, a complete Caſe, conſiſting of two Pair of Compaſſes, of which one Pair muſt be made with its Legs to ſcrew out, at ſuch Times when you deſire to deſcribe an Arch or Circle (with another Point) either of Black Lead or Ink.

A Drawing Pen, with a Protracting Pin, therein a Plain Scale, with divers Scales of equal Parts and Chords, a Protractor, and Sector.

Secondly, A Drawing Table, and Tea Square, with good Paper, Ink, Black Lead and Camel-Hairs.

Thirdly, Two or three larger Pair of Compaſſes, than thoſe of the Caſe, and a Parallel Ruler.

M. And are thoſe fully ſufficient for the Execution of my whole Studies?

P. No, but for your firſt ſetting out, they are ſufficient.

M. Pray, what may the other Inſtruments be called, and to what Uſe are they applied.

P. The other Inſtruments are ſuch that you will have Occaſion for when you come to the ſetting out and ſurveying of Buildings, as the Plain Table, Theodolite, Levels, *&c.* and if your Genius leads you to the Pleaſure and Study of Dialling, you muſt then be furniſhed with the beſt Kinds of Quadrants, *Gunters*, &c. univerſal *Ring-Dials*, large *Sectors*, the Uſe of which are accurately deſcribed in two Books publiſh'd, one by the Judicious Mathematician Mr. *Charles Leadbetter*, and the other by the late Ingenious Mr. *Samuel Cunn*, which are both ſold by *John Wilcox* in the *Strand*. But before you attempt the Study of the moſt curious Part of the Mathematicks, ſee that you are firſt well acquainted with the Principles here laid down, which I hope to find at my Return from Abroad.

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B M

THE PREFACE.

IT is a common Obſervation, that every Generation grows Wiſer, and I don't know any Thing that is a greater Confirmation, (to this old Saying) then to hear Artificers and Tradeſmen (when they meet together) relate their former Methods of Practice in their own Way of Buſineſs, and by comparing them with the Preſent, ſeem ſurpriz'd at the Improvements that have been made in their ſeveral Arts and Occupations whereunto they belong; From hence it's very plain, that there have been Men in all Ages, whoſe Ingenuity have led them out of the common Track, to find out nearer and better Methods to accompliſh their Deſigns, than they had ever been taught, or had before practic'd; And was a Man to indulge his Curioſity ſo far as to examine the ſeveral Employments of Life, I believe he would hardly find any that are ſo Mean and Trifling, but what would admit of a Difference in Practice, for how often may we find Men in trifling Employments, contending for ſuperiority of Judgment, and diſpute very *warmly about the different Methods of performing the ſeveral Branches of their Occupation. And if there is a Difference in the Practice of mean Employment, there is undoubtedly a great Deal more Difference to be diſcover'd in the Practice of thoſe Arts and Employments, that are of a more valuable Conſideration. The Art of Building alone will be ſufficient to juſtify the Truth of this Obſervation, for as this Art conſiſts of many Branches, it admits of many Practitioners, and as Mankind differ in their Abilities, it muſt conſequently cauſe a Difference in their Practice, and if a Man be ingenious, it gives him a great deal of Room to exerciſe his Fancy; for here, the Field of Art, layeth more often for the Mind to Range in, and is not confin'd to ſuch narrow Conceptions, as are very often found ſufficient to carry on a great many Employments of a lower Nature.*

Building if conſider'd in all it's Branches, is an Art very extenſive, and it muſt be allow'd to have receiv'd great Improvements within thoſe few Years paſt, but, whether that hath proceeded entirely from the many New Buildings lately erected, or from ſome other Cauſe, is not my preſent Enquiry.

The Theory, or deſigning Part of Building, hath always been eſteem'd preferable to the Practick, and Workmen have (for the

Generality) valued themſelves, and been eſteem'd by others, according as they have known more or leſs of it. For this Reaſon, one would think, that they would be very ready to embrace any Inſtruction, relating to the Theory of their Employment, for, I have very often known good Workmen, to be at a Loſs, for want of the Theory to direct them, and commit groſs Miſtakes, which the Knowledge of Lines would have prevented. For there is nothing that I know of, that can be of greater Service to any Mechanick, than to know the Theory of his Employment; and I have known ſeveral ingenious Workmen, belonging to the Building Trade, that by making cloſe Application to the Theory, have become good Surveyors.

And, indeed, they ought to be really ſo, that undertakes ſo ingenious an Employment; for it is not for every one that can make a fine Drawing, that is qualified to be a Surveyor, that being (in my Opinion) but the ſuperficial Part, for I can aſſure the Reader, that the original Deſigns of the great Inigo Jones, *were but poorly Drawn in Compariſon to the common Practice now known.*

I ſhould not have mention'd thoſe Drawings, had it not been to ſhew that there may be good Surveyors, without being fine Draughts-men, and the daily Practice of *ſome of our Moderns, plainly ſhew that there are fine Draughtſmen, that are not good Surveyors.*

By what I have here ſaid in Reſpect to Drawing, I do not mean to diſcourage any Perſon, from endeavouring to excel in that ingenious Art, nor to encourage any one to ſloven over a Deſign, but what I would obſerve, is only that there is a great deal of Difference between the Drawing and the knowing of Lines, in Reſpect to Building; for as the Knowledge of Lines, is the Baſe of the Mathematicks, it muſt conſequently be that of Architecture, and without them it would be impoſſible for one Man to convey his Ideas to another, in Reſpect to a Building; therefore, this the Architect ought to ſtudy well, and not only Lines, but Things themſelves, that he may be a Judge of the Materials required in a Building, and know (the better) how to apply them to their proper Uſe. In ſhort his Knowledge ought to be very Extenſive, his Fancy fruitful, his Judgment ſound, and be nicely juſt in all his Proportions, in Reſpect to Diſtance as well as Magnitude, that there may be a Symetry preſerved in all the Parts, both Internal and External; and if the Deſign be well adapted to the Situation, this Symetry will extend itſelf further, and bear ſome Analogy to the Landſkip it ſtands on.

This appears to me to be a very neceſſary Branch of Architecture, and I believe it is not always conſider'd in deſigning of a Building, or at leaſt is very ſeldom put in Execution, but whether it may be thought too nice for Obſervation, or whether it be not as yet rightly underſtood, I will not pretend to determine; but, however that be, I believe, it may (in many Situations) be introducid to a very good Effect, for it's a very common Obſervation, amongſt thoſe Perſons that have a Taſte of Gaiety and Dreſs, that Garments made of different Colours, and in different Shapes, will have a different Effect on the ſame Perſon that weareth them; So the Face of Nature, will undoubtedly bear the ſame additional Improvement, if the Complection and Features are rightly underſtood, and the Ornaments in a Building, are well adapted thereto by the Deſigner.

I ſhall forbear further Remarks, becauſe this hath already been obſerv'd in ſome Lectures *on* ARCHITECTURE *and* Harmonick Proportions *lately publiſh'd, in which, that Author by infallible* RULES, *and the Strength of a fine Imagination, hath carried this Obſervation to a greater Length than any Writer on this Subject, and hath there ſhew'd in a very delicate as well as* Poetical *Manner, what Orders of* Architecture *are moſt proper to* *to be apply'd to particular* SITUATIONS, *which, if rightly choſen, will preſerve that* Symetry *I have been ſpeaking of, and conſtitute a Kind of* Harmony *which will always be the Reſult of* Proportion *and* Regularity.

From what hath been ſaid on this Subject of Building, I think it appears very plain that it muſt require a great deal of Judgment, to delineate a good Deſign, and it is as evidently plain as much Ingenuity is required in the Artificers, to perform the ſame in a Workman-like Manner, for altho' it be not abſolutely neceſſary for all Workmen to have deſigning Heads, yet they ought to have conceiving Ones, that they may readily diſcover the true Meaning of the Architect, by forming to themſelves a good Idea, not only of the Whole of what they are to perform, but of the Parts alſo; that they may take the neareſt and beſt Methods to work the ſame, and put them together in a Workman-like Manner.

This I muſt own in many Caſes of Building, is very eaſy to conceive, and in a great many others very difficult, therefore, I would adviſe the Reader, (if he hath not already) to ſtudy the Nature of Lines, by learning a little Geometry, and by obſerving what Inſtructions he will find contain'd in this Book, he may ſoon be able to perform his Work in any irregular

lar Form or Shape that is requiſite or practicable to be perform'd in any Building whatſoever.

But, for the Sake of thoſe that are unacquainted with the Nature of Lines, I have begun this Undertaking with defining the Properties of thoſe Geometrical Figures, that have any Relation to the enſuing Problems. To the End, that the Practitioner may comprehend the Theory or Hypotheſis in Building, and ſee the Reaſon of what he is about to perform, which I flatter myſelf will anſwer his Expectation, whenever he hath an Occaſion to make Uſe of them.

But before I proceed to give any further Account of my own Performance, I muſt beg Leave to take Notice of the Performance of others that have wrote (before me) on the ſame Subject, which are only two that I know of, and they are Mr. Halfpenny *and Mr.* Hoare.

Mr. Halfpenny *in his Art of ſound Building, hath publiſh'd a Method to ſtrike out the Groins of Arches, the Angle-Brackets of Coves, and ſeveral other Things of the like Nature, and hath call'd it a* Geometrical *Method; how far the Contents will agree with the ſtrict Rules of* Geometry, *I ſhall leave thoſe learned Readers to judge, that have ſeen the Book; but for thoſe that have not, are to obſerve that his Method chiefly conſiſts in traceing of Lines, either by Way of Interſection,* *or by drawing them Parrelel from one Line to another, but the Reſult of both Ways was this; that you are to prick in Nails at certain Points, (determin'd by proper Direction) and bend a Lath round the ſame, and with a Pencil ſtrike the Arch or Curve according as the Nails and Lath directs, and that will be the Groin or Angle-Bracket required. Such a Line, (I muſt own) will be like the Groin or Bracket ſought, but then the Trouble and Time that is required to get at it, is what put me on thinking on ſome better Method, that might be ſooner perform'd, and to a better Effect.*

Mr. Hoare *was the next that had any thing to ſay to the Publick on this Subject, and by a long and ſpecious Advertiſement in a News-Paper, I was prevail'd on to purchaſe his Book, not knowing but that he might have taken the ſame Method I intended to take myſelf. But peruſing his Performance, I found he had followed the ſame Track that Mr.* Halfpenny *had mark'd out before him, and had perform'd very little, except reducing Mr.* Halfpenny'*s Folio into a ſmall Quarto, and by that Means rendered his own Performance a fit Companion for the Pocket, both in Reſpect to the Size as well as Price.*

This I muſt own was a Diſappointment for I had waited ſeveral Years in Expectation of ſeeing moſt of Mr. Halfpenny's Deſigns new Modell'd, believing ſome one or other would have diſcover'd a better Method, and have given it to the Publick in a much better Manner.

How far I have exceeded in that Reſpect, I muſt now leave to the Judgment of the Practitioner, who undoubtedly muſt know whether it is not a nearer and a better Method to ſtrike an Arch or Curve from a Center, than it is to trace them out by Lines, and after all that Trouble, be obliged to prick in a Parcel of Nails, and prepare a Lath fit for that Purpoſe, before you can ſtrike out the Line you want.

Surely there doth not want any deep Penetration to determine this Affair, for as moſt of the enſuing Problems have their Foundations in Geometry, they will bear a Demonſtration; therefore, it will be no difficult Matter to diſcover which of the two Methods are moſt Practicable.

I am not inſenſible that ſome of the Problems will appear mean and trifling to ſuch who have no Occaſion for ſuch Inſtruction, (and it's very likely) will think I have been too Particular, but if they will pleaſe to conſider that this is intended for general Uſe, and if they have no Occaſion for ſuch low In-

Inſtruction, there are ſeveral others that may who are not ſo expert in their Buſineſs as they, beſides, it is the common Way of moſt Authors that pretend to inſtruct in any Art or Science, to begin with the firſt Rudiments of that Art, and by gradual Steps advance to thoſe Rules that are more difficult, and this Method I have endeavour'd to follow as near as the Subject will admit.

I muſt own, that I have omitted ſeveral Problems, *that are to be met with in the Works of Mr.* Halfpenny *or Mr.* Hoare, *which I think have little or no Relation with our preſent Methods of Building, but inſtead thereof, I have ſubſtituted others in their Room, which I conceive to be more uſeful, but to make the Reader amends; I have beſtow'd ſeveral Pages on the Nature and Property of Arches, in Reſpect to their Shape and Duration, which Subject, naturally led me to make ſome Remarks and Obſervations on the intended Bridge at* Weſtminſter, *and likewiſe on what hath been publiſh'd on that Subject; And if what I have ſaid there or in any other Part of this Work, ſhould be of any Service to Mankind, ſo far as to give them any uſeful Hints, whereby the Theory of Building may be improv'd, I ſhall not think my Leiſure Hours loſt or any Ways miſemploy'd.*

J. GADSDON.

B M

DEFINITIONS.

AN Angle is an Indefinite Space terminated by the Meeting of two Lines which interſect or touch each other on a Plane, and may be either right-lined, curved or mixt.

A right-lined Angle is that which is made by the Interſection or Meeting of two right Lines, as A, the Point at *a*, being the Point of the Angle.

A curved Angle is that which is made by the Meeting of two Curves, or crooked Lines, as, *b*.

A Mixt is made by the Interſection of a right Line and a crooked or curve, as *c*.

Angles whether plain or ſpherical may be either right, acute, or obtuſe.

A right Angle is when one Line falls perpendicular on another, as *d*; it conſiſts of 90 Degrees or one Quarter of a Circle, a Circle being commonly divided into 360 equal Parts called Degrees.

An acute Angle is any Angle that is leſs than a right one, as E, or that conſiſts of leſs than 90 Degrees.

An obtuſe Angle is greater than a right one, or that conſiſts of more than 90 Degrees, as F; ſuppoſing the dotted Line in each Figure to repreſent the intended right Angle.

A Triangle is a Figure that hath three Sides and three Angles, as G.

Any three whereof being given (except the three Angles) the other three may be found.

In any Triangle the three Angles taken together are equal to two right ones. Wherefore having any two given, the third is known of Courſe by ſubſtracting the Sum of the given ones from 180 Degrees.

In a right-angled Triangle where one Angle is a right one, the other two are neceſſarily acute. And both together are equal to 90

Degrees,

B M

Degrees, wherefore one is always the Complement of the other to a Quadrant.

A Segment of a Circle, is a Part of a Circle terminated by a right Line leſs than the Diameter, and by a Part of the Circumference, as A.

CHAP. I.

On the CIRCLE, *&c. with their Properties.*

Firſt, A Circle is a plain Figure contain'd under one Line, as the Line AAA in *Fig.* 1. which Line is called the Circumference, or Periphery, and all ſtraight (or right) Lines paſſing through the Center *a*, and touching each Side of the Circle are call'd Diameters, as the Line B, the Half of which is called the Radius, or Semidiameter.

Half a Circle is called a Semicircle. All ſtreight Lines, as C, not paſſing through the Center of a Circle are called Chord Lines, and the Parts ſo cut off are called Arches or Segments of a Circle.

Secondly, An Ellipſis, or Oval, is a Figure contained under one Line, and differeth from a Circle according to the Difference of its Diameters,

meters, as in *Fig.* 2. the ſhorteſt Diameter B is called the Conjugate; the longeſt C is called the Tranſverſe.

Theſe Figures have ſeveral Properties, which I might enlarge upon, but as they will be of no Uſe in the following Sheets I omit them.

Thirdly, A Cylinder is a ſolid Body, round and long, whoſe Sides are parallel, or at equal Diſtance one from another, as in *Fig.* 3. the Ends being ſquare (or at right Angles) with the Sides muſt conſequently be a Circle, as A. But if they are cut obliquely, they become Ellipſis's, as the Section D, and according to what *Obliquity* the Ends are cut the *tranſverſe* Diameter will increaſe, but the Conjugate will always remain the ſame.

Fourthly, A Cone is a ſolid Body, round and wide at the Bottom, or Baſe, and diminiſheth to a Point at the Top reſembling a Sugar Loaf; ſee *Fig.* 4. It hath the ſame Properties that the Cylinder hath, in Reſpect to the Ellipſis and Circle; for if it be cut at right Angles to the Axis, or Middle Line A, that Section will form a Circle, but if cut obliquely, (as the Section B,) 'twill form an Ellipſis; but as the Ellipſis cut from a Cylinder can be enlarg'd larg'd but one Way, thoſe cut from a Cone may be enlarg'd both Ways, but not in the ſame Proportion. A Line made perpendicular thro' the Center is call'd the *Axis* of the Cone, and if the Top of it be cut off; the Part remaining is called the *Fruſtrum* of a Cone.

This Body admits of many more Sections and Properties, which would be of no Uſe to define here, and for that Reaſon are omitted; but as to theſe I have mentioned, I muſt deſire the Reader to take Notice of them; the Cylinder eſpecially. And if he doth not conceive the Sections by the Figures it will be beſt to make the Bodies themſelves of Wood or other ſoft Matter, and cut them according to Direction, and he will ſoon diſcover that a Cylinlinder cut obliquely will be an Ellipſis; and as all ſemicircular Arches are Half-cylinders, their Groins, or Miters, muſt conſequently be Half-Ellipſis's. But of this more hereafter.

CHAP. II.

Some Introductory Problems.

PROBLEM I.

On a right Line given as A, *to raiſe a Perpendicular.* Fig. 5.

OPEN your Compaſſes to the Length of the whole Line, fix one Point at *a*, and extend the other Point to *e*, and make a Scratch; then fix your Point in *c*, and make another Scratch at *e*, then take Half that Diſtance you have in your Compaſſes, and ſet it off on the given Line at A; and a Line drawn from the Point A, to the Point *e*, where the two Scratches interſect will be perpendicular to the given Line *a*, *c*.

PROBLEM II.

To raiſe a Perpendicular at the End of a Line given as A. Fig. 6.

Proceed as if you were to raiſe a Perpendicular from the Middle of the given Line, then draw the Line B, through the Interſection of the Scratches C at Pleaſure, then ſet off the ſame Diſtance you have in your Compaſſes upwards from C, on the Line B, and from thence draw a Line to the End of the given Line A, at *d* to *e*, which will be at right Angles, (or perpendicular) to the Line A.

PROBLEM III.

Any Part of a Circle being given to find the Center be it more or leſs than a Semicircle. Fig. 7.

Let ABC be the Segment (or Part of a Circle) given; draw the Chord Line AC, then raiſe a Perpendicular from the Middle E of the Line AC, at Pleaſure, then draw the Chord Line A B, and from the Middle D, of that Line, raiſe another Perpendicular and the Point F, where that interſects the other Perpendicular, will be the Center required.

PROBLEM IV.

A Line being given, divided into any Number of Parts; to divide another given Line in the ſame Proportion, as Fig. 8.

Suppoſe the Line A, divided into equal or unequal Parts, as, *a b c d e f g*, and the Line B be required to be divided in the ſame Proportion; make A the Baſe, and B the Hypothenuſe of a Triangle, draw the Line which compleats the Triangle, draw Lines from all the Diviſions, *a b c*, &c. parallel to that Line, and they will divide the Line B, in the ſame Proportion.

This is a very uſeful Problem, and may be ſerviceable to Workmen on ſeveral Occaſions; for if a Man hath any Moulding (that conſiſteth of many Members) ready drawn out, and wanteth another of the ſame Sort, either larger or leſs, this Method will give it him ſooner than to divide it anew; nay ſhould he want to lengthen or ſhorten any one Order, with its proper Pedeſtal and Entablature (if he hath Room to lay down the Lines) he may perform it by this Method. And if he hath not Room, it may be done in Parts, obſerving to ſet off each Line, or Part, in the ſame Angle.

Mr. *Halfpenny* and Mr. *Hoare* have been ſo fond of this Problem, as to make it the Baſis of moſt of their Schemes, and have carried it through all their Deſigns relating to Curves, in order to find out the Groyns of Arches; the Angle Bracket of Coves, and ſeveral other Deſigns of the like Nature. But I hope the Reader will find in the following Sheets a much better Method; a Method that will not require a great many Lines, no Nails, nor bended Laths to ſtrike the Curve; but performs it by Centers; this I ſhall endeavour to make eaſy and familiar to the Practitioner by giving the Theory as I go on, and deſcribing ſuch Inſtruments as are proper to perform it, and as the Trammel is the beſt and uſefulleſt Inſtrument, I muſt deſire thoſe Readers that are unacquainted with it to obſerve the following Deſcription.

A Trammel is form'd of two Pieces of Wood croſſing each other at right Angles in the Middle; (as in *Fig.* 9.) with a Grove plow'd in the Middle; and when fitted together the Groves muſt be cut, one into the other; the Length you muſt proportion according to your Deſign, and brace them as you ſee in the Figure. Then prepare a Rod with two moving Centers, or wooden Pins, and fit them to the Groves, ſo as they may ſlide up and down at Pleaſure; then uſe it in the following Manner.

Note, As Joyners and Carpenters very ſeldom want above half an Ellipſis in their Way of working the upper Part will be uſeleſs, and one in the Form of a T will do as well.

PROBLEM V.

To ſtrike out an Ellipſis with a Trammel to any given Proportion. Fig. 10.

Suppoſe you would have one, 6 Feet by 4, take half your longeſt Diameter (which is 3 Feet) and ſet off from the Tooth or Pencil at the End of the Rod to make the Mark; and there fix one Center; then take Half the ſhorteſt Diameter and ſet off as before, and there fix the other Center, then apply the Rod to the Trammel by putting Centers or wooden Pins into the Groves and move the Rod quite round the Periphery A, B, C, D keeping the Centers in the Groves, and that will deſcribe the Ellipſis required.

PROBLEM VI.

To ſtrike out an Ellipſis with a Pair of Compaſſes to any given Proportion. Fig. 11.

Take the Difference between the two Diameters, and divide into 3 equal Parts, take two of them, and ſet off on each Side the Center on tranſverſe Diameter, as B and E, take the whole Diſtance between B and E in your Compaſſes, and fix one Point in either B or E, extend the other to the Conjugate Diameter, and where that Point falls on that Line as at D and F; from thoſe Points draw Lines at Pleaſure as you ſee in the Figure; then from B as a Center ſtrike the Arch A, and from E, the other Arch A; then from the Center F, ſtrike the Arch *a c b*; and from the Center D, the Arch *d* G *f*, and all thoſe Arches will meet where thoſe ſtreight Lines interſect and form an Ellipſis.

This Ellipſis will be as true a one as can be drawn with a Pair of Compaſſes, and fit for any Uſe; but if conſidered in a mathematical Way, it cannot have the true Properties of an Ellipſis, becauſe their Centers are always moving, whereas thoſe being fix'd can only ſtrike ſuch Curves as will co-incide, and appear very much like a true one. Beſides this Sort of Ellipſis may be drawn parallel, which the true ones cannot, becauſe they flow from a right Line and want to get into a Circle, as may be be eaſily prov'd by firſt drawing one, whoſe Conjugate Diameter ſhall not exceed an Inch, and the Tranſverſe not be leſs than two Feet: I ſay, if you endeavour to draw other Ellipſis's parallel to ſuch an Ellipſis, by increaſing both the Diameters alike, and draw a great Number you will have one at laſt very near a Circle;

and may be diſcover'd by meaſuring between the Diameters of the firſt and the laſt that they are not parallel, and if thoſe two are not 'tis impoſſible any other two ſhould.

PROBLEM VII.

To ſtrike out an Ellipſis with a String. Fig. 12.

This Method is moſt commonly made uſe of, and performs the ſame as a Trammel, if the String would not ſtretch, but as all Lines are of a ſtretching Nature, it cannot be uſed with that Certainty that in many Caſes is required, but may be made uſe of in a great many others, obſerving the following Method.

Take Half the Conjugate Diameter in your Compaſſes, and ſet one Point at the Center and the other at either End of the Tranſverſe, extend the other, and where that falls ſtick your Nails as at A and B, for the Center's; then take a String, or Line, the leaſt apt to ſtretch you can get, put it round the Nails and tye it to ſuch a Length that your Pencil C may juſt reach the End of one of your Diameters; then keeping the String equally tight, let it work round the Nails, and your Pencil will ſtrike this Ellipſis.

Note, There is another Method that may be made uſe of to ſtrike the Quarter of an Ellipſis; which is to fix a ſtreight Piece of Wood a-croſs a Drawing-Board, at right Angles with the Side, then take a Rod half the Length of of the Tranſverſe Diameter, and from the Pencil End ſet off Half the Conjugate Diameter on the lower Side of the Rod, and there ſtick in a Nail, or Pin, to work along the Edge of the Drawing-Board; the End next the Pin make round to work againſt the Edge of the Piece nail'd on the Board, and that will perform the ſame as a Trammel, as far as it will go.

The Definitions and Problems hitherto laid down are only introductory to what will follow, the Theory whereof depends upon them; which Definitions and Problems, if the Reader will but give himſelf a little Time and Application to underſtand, the following Propoſitions will be more eaſily perform'd and better underſtood.

CHAP. III.

PROBLEM I.

To find the Groin Arch of two Semicircular Arches that interſect or croſs each other at right Angles. Fig. 13.

THE Theory of this Problem depends on a Cylinder, which being cut obliquely will be an Ellipſis, and as all ſemicircular Arches are the Half of Cylinders, the Groins, or Miters, of ſuch Arches muſt conſequently be Half-Ellipſis's, and may be found by the following Method.

Suppoſe the Arch A, to riſe three Feet and Spand ſix, or any other given Proportion; let fall the Perpendicular B at one End of the Diameter C, and equal to it, which will be two Sides of a Square; then draw the Diagonal Line D, and that will be the Tranſverſe Diameter, and the Line C A will be the Conjugate, which ſet at right Angles in the Middle of the Tranverſe D, as the Line E, then take a Trammel, or String, and ſtrike the Ellipſis F, F, F, the Half of which will be the Groin ſought.

PRO-

PROBLEM II.

To find the Groin Arch of two ſemicircular Arches, that interſect one another obliquely, as in Fig. 14. Plate 2.

Suppoſe them of the ſame Demenſion as the laſt, or any other, you muſt draw the Plan of their Interſection as you ſee in the Figure, then draw the Diagonals, A and B, and they will be the Tranverſe Diameters, the Conjugates will always continue the ſame; then proceed as directed in *Prob.* I, and this Method will find out the Groin be the Angle of Interſection what it will.

PROBLEM III.

To find the Groin Arch of two Elliptical Arches, whoſe Tranſverſe Diameters are horizontal or level, and interſect at right Angles. Fig. 15.

Suppoſe it were required to find the Groin of the Elliptical Arch E, you muſt proceed as in *Prob.* I. to ſquare the horizontal tranſverſe Diameter A, and take the Diagonal Line B for your Tranſverſe Diameter of the Groin and the dotted Line C will be the Conjugate; proceed as before directed, and the Half of the Ellipſis K, K, K will be the Groins ought; and if the Arches croſs obliquely you muſt proceed as directed in *Prob.* II.

PROBLEM IV.

To find the Groin Arch of two Elliptical Arches, whoſe Conjugate Diameter is horizontal, and interſects at right Angles. Fig. 16.

In this you muſt proceed, as in the former, by ſquaring the horizontal Line A, (which in this Arch is the Conjugate Diameter) and take the Diagonal Line C, for a new Diameter, but whether it will be a Conjugate, or a Tranſverſe, the Diameters of your firſt Ellipſis will determine; for, if they are in the ſame Proportion, as the Side of the Square is to its Diagonal, the Groin Arch will be a Semicircle, but let the Proportion be what you pleaſe, if you take the dotted Line D, and the Line C, for the Diameters of the Ellipſis that is to form the Groin, they will tell you which will be the Conjugate, and which the Tranſverſe; but let that happen as it will, the Line C muſt always be the horizontal Diameter, and the Half-Ellipſis, or Circle, on either Side that Line will be the Groin ſought.

PRO-

PROBLEM V.

To find the Groin Arch of a ſemicircular Arch meeting with one that is Elliptical at right Angles, as in Fig. 17.

Notwithſtanding theſe Arches differ their Groins will be both alike, and may be found by drawing the Plan of their Interſection, and taking the Diagonal for the Tranſverſe Diameter, and the dotted Line A for the Conjugate, ſtrike the Ellipſis B, B, B, the Half of which will be the Groin ſought.

Note, All Arches that are of different Spand, and are to interſect each other, one of them muſt be elliptical, otherwiſe they will not riſe to the ſame Height and coincide one with the other; and if they are both elliptical and differ in Diameters, the Method is exactly the ſame.

PROBLEM VI.

To find the Groin Brackets, where a ſmall Arch is cut out of a larger, and both are Semicircles. Fig. 18.

When theſe ſmall Arches are cut off of large ones, it is commonly introduce a Window or

Door, and the Groin Brackets may be found by the following Method; draw the Plan of the great Arch A, then draw the little Arch B on the Side, as you ſee in the Figure; and from the Ends D D, of the Arch B, draw the Lines K and L, through the Middle Point, *c*, and either of them will be the Tranſverſe Diameter of the Ellipſis, *o o o*, and the Conjugate will be the Diameter of the great Arch A, and the two Groin Brackets will be the Arches R T, which are cut off by the Line L; theſe you muſt place exactly over their reſpective Diagonals L and K, and let the two flatteſt Ends meet together and ſtand uppermoſt, then will the little Arch B meet and coincide with the great Arch A, and be the Quadrant O, D, T, D.

I could give ſeveral other Problems of this Nature, but I believe the Reader by this Time is ſo well acquainted with my Method of Proceeding, that to give any more would look like an Affront offer'd to his Underſtanding; for if he hath diſcover'd the Theory of what I have hitherto advanced on this Subject, there can be no Arches that are compos'd of the Ellipſis, or Circle, but he may find out the Groin thereof, let them meet or croſs each other how they will.

PRO-

PROBLEM VII.

To find the Angle or Corner Bracket of a Cove that 's Part of a Circle, as Fig. 19.

As all Coves are Parts of Arches, ſo all Angle Brackets muſt be Parts of their correſponding Groins; for Example, Suppoſe it was required to find the Angle for the Cove A, you muſt proceed (as in *Prob.* I.) as if you were to find the Groin of the whole Arch, and ſtrike the ſame Ellipſis, B B, and place it as you ſee in the Figure; then continue the Line C, (which limits the Progreſſion of the Cove) till it meets with the Tranſverſe Diameter of the elliptical Arch B B, and from thence raiſe the perpendicular Line D, and that will cut off juſt as much as will make the Angle Bracket B of the Cove A.

But if the Room be not ſquare, or the Sides not at right Angles one to the other, and it is not a great deal out of Square; you muſt draw the Plan of the Projection of the Cove according te the Angle of the Room, as the Figure B, and ſet off the Line A, from one End of the Ellipſis on the Tranſverſe Diameter, and from thence raiſe a Perpendicular, and that will cut off the Part required for your Angle Bracket, *Fig.*

Fig. 20. And if it be very much out of Square you muſt draw the Plan of the whole Room, as the Figure 21, and ſet off the Diameter of the Circle that forms your Cove and draw Lines parallel to the Sides, as you ſee in the Figure, and take the Lines B and D for the Tranſverſe Diameters, and the Conjugate Diameters will be the Diameters of the Circle that form'd the Cove; then proceed as before directed.

N. B. This Method will do for Hexagons, Heptagons, or any right-lined Figure whatſoever.

PROBLEM VIII.

To find the Angle Bracket of an Elliptical Cove; Fig. 22; *whoſe tranſverſe Diameter is horizontal as the Cove,* B.

Square the horizontal Diameter of the Ellipſis that forms the Cove, and proceed as in *Prob.* VII to ſtrike out the Ellipſis, C D, then continue the Line E, till it meets with the Tranſverſe Diameter of the Ellipſis C D, and from thence raiſe a Perpendicular K, and that will cut off the Arch C, which will be the Angle Bracket required.

PROBLEM IX.

To find the Angle Bracket of an Elliptical Cove, whoſe Conjugate Diameter is horizontal as the Cove. Fig. 23.

Square the Horizontal Diameter of the Ellipſis that forms the Cove K, and proceed as before taught, to ſtrike the Ellipſis R, T, then continue the Line O, till it meets with the Line D, and from thence raiſe the Perpendicular L, and that will cut off the Arch R, which will be the Angle Bracket required.

But here it is to be obſerv'd, that as in the foregoing Problem, the new Ellipſis that form'd the Angle Bracket became longer, here it may become ſhorter, for if the Diameter of the firſt Ellipſis be in the ſame Proportion as the Diagonal is to the Side of a Square, the Angle Bracket may be Part of a Circle; and if the firſt Ellipſis be a long one; the Diagonal Line D, will become the Conjugate Diameter of the new Ellipſis that is to form the Angle Bracket, by making the dotted Line E to form the Riſe of the two Diameters F and F to be equal.

N. B. I have thought proper to ſhorten the Directions of ſome of the Problems concerning Coves, becauſe the Method is exactly the ſame, and may be applied to any Cove that is Part of any Ellipſis, or Circle, take it out of what Part you pleaſe, for the Line of Projection being continued until it meet with the Diameter D, and from thence a Perpendicular being raiſed, it will cut the correſponding Part required, as you ſee in the above Figure, the Riſe being always conſider'd equal in both, and is made by a Line parallel to the Conjugate Diameter D.

CHAP. IV.

PROBLEM I.

To glew up the Crown of a Buffet, whoſe Front and Back are both Semicircles. Fig. 24.

THIS Sort are in moſt common Uſe, and are the eaſieſt to be conceiv'd; they are perform'd by the following Method. Take a thin Piece of Board for your Mold, which muſt be juſt Half the Semicircle, as the vacant Space D, in the Figure; divide this according to to the Thickneſs of your Stuff, as you ſee in the Figure, and let the Joints croſs each other in the Plan; then take the Line, *a*, for your firſt Center, the Line, *b*, for your ſecond, and ſo on till you have compleated the whole Crown, obſerving to ſet a Bevel to every Thickneſs, according as you find them on the Compaſs Edge of the Mould, and work the Pieces by the ſame, then glew them down one upon another, and that will form the Crown required.

To glew up the ſame in a different Manner proceed as before directed, and glew up three or four Rounds (as will ſuit your Deſign beſt) then take them off your Board and glew up the ſame Quantity, and ſo on till you have got enough for the whole Crown, then glew together in Parts. This Method is moſt proper when the Crown is not to be painted.

PROBLEM II.

To glew up the Crown of a Buffet, whoſe Front and Back are both Elliptical. Fig. 25.

To perform this you muſt have two Moulds one muſt be the Quarter of the Ellipſis B, the other a Quadrant, or Half a Semicircle, as the Space A, theſe you muſt divide according to the Thickneſs of your Stuff, then will the Lines on the Quadrant be Half the Conjugate Diameter, and the Lines on the Elliptical Mold will form be half the the Tranſverſe Diameter of all the Elliptical Pieces that form the Crown ; that is the Line O, will be one Center, the Line, *a*, the other of the firſtPiece you glew on ; and the next Lines, *viz.* *b*, *c*, will be the Centers of the neat Pieces,and ſo on: And the Quadrant Mould will give you thoſe at the Ends; then proceed as directed, *Prob*: I.

PROBLEM III.

To glew up the Crown of a Buffet, whoſe Front is a Semicircle and the Back elliptical. Fig. 26.

This Sort of Buffet is very often introduc'd where the Receſs that is to receive it is ſhallow, and not half ſo deep as it is wide.

The Method of performing it differs very little in Practice from the laſt, and the Difference is in the elliptical Mould, which in the former is on the Conjugate Diameter, and here you muſt divide on the Tranſverſe, as you ſee the Space G, is in the Figure ; then begin with the Lines O, and A for the two firſt Centers, and proceed as before directed.

PRO-

PROBLEM IV.

To ſtrike out the Ribs of the Crown of a Buffet that is to be plaiſter'd, and is a Semicircle both Ways. Fig. 27.

This Sort of Buffets are often plaiſter'd when they are very large, and will admit of being enrich'd with Fruit, Flowers, a Shell, or any other Ornament, according to the Fancy of the Deſigner. Firſt, Strike out the Back Plate, and divide it into the Number of Ribs you deſign for the Crown, as the Figure D, and from the ſame Centers ſtrike out the Ribs which will be Quarters of Circles, and fix one End to the Back-Plate, and the other Ends muſt meet altogether in the Center of the Crown, and they will form the Crown required.

PROBLEM V.

To ſtrike out the Ribs of the Crown of a Buffet that is plaiſter'd, whoſe Front and Back are both elliptical. Fig. 28.

Firſt, Strike out the Back and Front, according to your Dimenſions, as before directed, and divide the Back into the Number of Ribs you deſign for the Crown, and from thence draw Lines to the Center, as you ſee in the Figure B, then take the Line O for one Center, and the Line *a* for the other, and ſtrike the Semi-Ellipſis C, and that cut into two at Z, (*Fig.* 29.) will be the two firſt Ribs next to the Front, then take the Line *b*, for the next longeſt Center to work with the Line O, (which being a fix'd Center to them all, muſt remain the ſame) and they will ſtrike the next two Ribs, and in like Manner proceed till you come to the Middle, O, which will be a Center of itſelf for the Middle Rib, then fix them in their proper Places, obſerving to let the Ends which are cut in ſunder, meet altogether in the Center of the Crown, and fix the other Ends to the Back Plate to follow one another as they were ſtruck out.

PROBLEM VI.

To ſtrike out the Ribs of a Buffet that is to be plaiſter'd, whoſe Back is elliptical and Front a Semicircle. Fig. 30.

The Method of performing this is nearly the ſame as the laſt, (*viz.*) firſt draw the Back and Front, then divide the Back according to the Crown; and from thence draw Lines to the Center, as you ſee in the Figure, then proceed as directed in the former Problem, *viz.* to take the whole Line O, for one Center, and the Line *a*, for the other, which will be a little ſhorter, and therefore will produce a Semi-Ellipſis nearly a Semicircle, which being cut in two will be two firſt Ribs next to the Front, then take the Line *b*, for the next Center to work with the Line O, which is the fix'd Center to them all) and that will ſtrike the next two Ribs, and ſo proceed on till you have compleated the whole Number, then fix them in their proper Places only obſerving that as in the laſt Problem the Ends where they cut in two went to the Crown, here they muſt be fix'd in the Back Plate, and they will form the Crown required.

PROB. VII.

To frame the Crown of a Buffet that is a Semicircle both ways. Fig. 31.

This Sort of Buffet is not very common, there being a great deal of Care and Trouble required to work them clean; by Reaſon the Mouldings muſt be ſtruck by Hand and moſt of the Plowing will be againſt the Grain; but thoſe that have a Mind to work one after this Manner may obſerve the following Method.

First,

Firſt, Glew up the framing (as directed in *Prob.* I.) until you have enough for the Front Stile O, and likewiſe for the Spandrel Rails, *a*, *a*, *a*, *a*, which muſt diminiſh, as you ſee in the Figure, and be mortiſed into the Compaſs Place *e*, which muſt be worked by a Mould ſtruck from the Center as your Framing, and muſt be mortiſed into the lower Rails, *a*, *a*, whoſe lower Edge muſt be rebatted to receive the Back, then ſet off from your firſt Center, the Thickneſs of the Moulding you ſtick on the Framing, and that will ſtrike the Mould to work the Pannels by; which muſt be glew'd up by the ſame, ſo that the Joints may lie horizontal, or level as the Pannel D, in the Figure; for were you to make a Pannel never ſo thin, and think to bend it, you will be deceiv'd, for that will not form a regular Curve both Ways; therefore it is much the better Way to glew them up, as before directed.

PROBLEM VIII.

To Vinear the Crown of a Buffet in Goars that is a Semicircle both Ways. Fig. 32.

A Buffet finiſh'd after this Manner is alſo very uncommon, for I do not remember to have ſeen above two, and they are both in

Hampton Court Chapple; and (in my Opinion) have a very good Effect. And as it is natural to moſt Mechanicks, when they ſee any Thing uncommon perform'd in their own Way of Buſineſs, to have ſome Thought about the Method that was taken to perform it; therefore this Conſideration prevail'd with me ſo far as to recommend the following Method to perform the ſame.

Suppoſe the Semicircle D, to be the Back of a Buffet, you muſt divide it according to the Number of Goars you deſign, then draw the Line *a*, equal to the Semicircle D, and ſet off Half the Breadth of your Goar on each Side the middle Point *c*, and from thence raiſe a Perpendicular at Pleaſure as the Line *z*; then from the Half-Breadth of your Goar, *viz.* from the Point *a*, draw a Line to either End of the Line *a*, as the Line *o*, and from the Middle thereof raiſe a Perpendicular, as the Line *x*, and where that meets with the other Perpendicular *z*, will be the Center to ſtrike the Curve Line *n*, *n*, which will be one Side of the Goar; then perform the ſame on the other Side as *m*, *m*, for the other Side of the Goar; which being cut in two at *c*, will make two Vinears in the Shape required. And by the ſame Method you may ſtrike out all the reſt: then glew them down with the broad Ends towards the Back, and the piked Ends will all unite in the Center of the Crown.

N. B. This Method is very likely to do if the Goars are narrow, and the Vinears very thin, but if they exceed two Inches and a Half or three Inches at the Bottom, the ſafeſt Way will be to let the Vinears be thick enough to be work'd by a Mold (broadways) on the Backſide, and bend them longways only, and work the Inſide (after it is glew'd down.) And I am apt to believe that thoſe at *Hampton* Court were work'd after this Manner; for their Vinears ſeem'd to me to be ſix Inches at the Bottom, and for that Reaſon (I think) it impoſſible to be laid in a thin Vinear becauſe the Middle Line *a*, muſt become as long as the Curve Line *n*, *n*, otherwiſe it will not ſtick in the Middle. But let the Vinear's be broad or narrow, the Method I have here given will ſtrike out the Compaſs Line for the Edge. But when the Vinears are very narrow, the Difference between the middle ſtreight Line, and the Compaſs-Line on the Edge is ſo very little, it is poſſible that when the hot Glew comes upon it, it may ſtretch a little, and by that Means lie faſt.

As to the Directions I have given in this Problem, or any other that regards the working Part only, I muſt deſire the Practitioner to obſerve them as ſuch as I ſhould make uſe of myſelf; and not as poſitive or abſolute; for as ſeveral Men have different Ways of working the ſame Thing, it is probable they may find out better, but as the Theory is built on Demonſtration they may be ſafely relied on by thoſe that have Occaſion to make uſe of them.

PROBLEM IX.

To ſtrike out a Compaſs Soffite that is horizontal at the Crown, and ſplays at both Ends according to the Shutters. Fig. 33.

Firſt, Find the Center that ſtruck out the Head of the Arch by *Prob.* iii. *Chap.* II. then ſet off the Margin you intend to ſhew, and ſtrike the Edge of the Stile next to the Window-Frame; ſuppoſe the Arch D, all the other three will be elliptical, and may be found by the following Method.

Firſt, draw the Plan of the Soffite, as if it were to be a flat one, as you ſee in the Figure, *viz. a*, repreſents the Back Stile, and *e* the Front; then ſet off the Splay and draw the Line O*, and where that cuts the Stile Line, let fall a perpendicular Line to the Line, *b*, and they will give the Splay of the Stiles, and likewiſe the Pannell. Then take a Trammel and fix directly over the firſt Center, as you ſee in the Figure; then take the Rod that belongs to the Trammel, and fix the Pin next the Tooth or Pencil, to the firſt Center, E, and put in the upper Grove of the Trammel; then bring the Tooth or Pencil to the firſt Splay, *n*, and obſerving where the Rod croſſes the lower Grove of the Trammel, there fix the other Pin of the Rod, then will the Trammel be fix'd to ſtrike the firſt Splay *n*, and by the ſame Method ſtrike out all the other Splays. But if the Soffite be very flat Parts of a Circle will do inſtead of Elliptical Parts, and the Centers thereof may be found by *Prob.* iii. *Chap.* II.

N. B. As there are ſeveral Ways of Glewing up thoſe Sorts of Soffites, I have omitted giving any Directions here, and muſt refer the Reader (if he doth not know of any better) to thoſe I have already given in ſeveral of the foregoing Problems relating to Compaſs Work.

PROB.

PROBLEM X.

To find the Return of the Cornice of a Pediment. Fig. 34.

Draw out the Cornice according to the Angle of the Pediment, then raiſe a Perpendicular any where ſo as to interſect the Cornice, as the Line O, *Fig.* 1. and from that Line ſet off the Projection of the Cornice on a Level, and draw out the Members as you ſee in the Fig. F and that will be the Return. But if your level Cornice be firſt given, and you want to find the Pediment or raking Part, draw out the level Cornice F, *Fig.* 1. and raiſe a perpendicular Line, as O, and from thence ſet off the Projection and return it as you ſee in the Figure; then draw the Lines of the Pediment Cornice, G, L, H, M, *&c.* according to the Angle of Interſection; and from a Line at right Angles give it's proper Return, as L; and that will be the Cornice required, and the Ogee which returns round the Modillion H. There are ſeveral other Caſes where Moldings require to be enlarg'd to make them a Quadier, that is to make all the Members meet, for if a Semicircle Molding meet with a ſtreight one, as the *Fig.* 35. and the Joint be a true Miter, at 3 the Compaſs Part will be larger than the ſtreight one. But if the Compaſs Part be the ſame Breadth as the ſtreight one, and the Members in the ſame Proportion, then will the Interſection form a crooked Joint, as *Fig.* 4; therefore in ſuch Caſes, as I have here deſcrib'd (if it is not to be a true Miter) I conceive the beſt Method is firſt to draw the Out-lines of both the Moldings of the ſame Width as in *Fig.* 5; and from their Interſection draw the Miter-line O, then draw the Members of the ſtreight Parts, and from where they interſect the Miter-line O, draw the Members of the Compaſs Part, and they will be in the ſame Proportion.

N. B. The Inſtructions I have here given relating to Moldings, I muſt own will be of little or no Service to a great many Workmen, they being very common in Practice and not very difficult to underſtand; but as I deſign this Book for general Uſe, this Problem may be uſeful to the younger Sort of Practitioners, and for that Reaſon I thought proper not to omit it.

PROBLEM XI.

An Architrave being given as E 1*ſt*, *to draw another in the ſame Proportion as the Architraves* B *and* D, Fig. 36.

This depends on *Prob.* 4. *Chap.* II. where you are taught to divide a Line in the ſame Proportion as another given Line is divided. If you want a leſſer than the given one E 2d, ſet off your deſign'd Breadth from the Foot of E, at an Angle you pleaſe, and from the Diviſions of the given Architrave E, draw parallel Lines, as you ſee in the Figure, and that will divide the Architrave D, in the ſame Proportion. And by the ſame Method you may draw a larger one, as B, *Fig.* 37. and as all the Members are work'd down as far as they are work'd on the Thickneſs will be increaſed in the ſame Proportion, by obſerving to ſet off the firſt Facia the ſame Thickneſs as the Bead is to work on, which is given by the parallel Lines, and the Thickneſs of the Second Facia and the upper Ogee are found by the ſame Method, or the Thickneſs may be found by drawing parallel Lines, as the dotted Lines plainly ſhow.

PROBLEM XII.

To find the Length of the high Rafter of a Roof be it bevel or ſquare.

Firſt, On ſome convenient Floor, or large Drawing-Board, draw the Out-lines of the Building, according to the Angles, and let B,C,D,E, repreſent the Out-ſide of the Plate, *Fig.* 38; then from the ſquare End C, give the Roof its proper Pitch, and draw the Lines O, O, for the common Rafters, and divide the Line C, into as many Parts as the Building is Feet wide, and the laſt Diviſion, divide into twelve Parts for Inches, and that will be a Scale to meaſure any Part of the Roof: Then draw the Middle-line repreſented by the dotted Line A, and draw the dotted Lines *p, p,* the ſame Diſtance from the Ends as the Line A, is from the Sides, and from the Points where theſe Lines interſect, or croſs each other, draw the Lines *d, d, d, d,* which will be the Projection of all the Hip Rafters, then take the dotted Line *m,* (which is the Height of the Pitch) and add to each of the Lines *d, d, d, d,* and from thence draw the Lines *b, b, b, b,* as you ſee in the Figure, and they will be the Hip Rafters of the whole Building. And if you want to find the Length of the ſhort Rafters make a right Angle Triangle, A, *Fig.* 39. and let the Hip *b*, be the Hypotheneuſe, the common Rafter C, the oppoſite Side, and the Baſe, Half the Breadth of the Building; which divide according to the Diſtance you intend for the Rafters, as you ſee in the Figure A, and apply them to the Scale; and that will give you the exact Length of any of them, and the Figure will give the Bevel of the upper Ends.

The Bevel or Back of the Hip-Rafter may be found by dividing the Hip with a Line down the Middle, after 'tis cut off to its proper Angle, and from that Line as a Diagonal ſet off the Angle of each Corner of the Building, and that will give you the Bevel.

N. B. This Problem depends on the Nature of all right-lin'd Figures, in which if the Meaſure of any one Part be known, it will meaſure all the Reſt.

PROBLEM XIII.

To find the Hip or Angle Rafter of a Roof whoſe Plan is an Octagon or Hexagon. Fig. 40.

Firſt, Draw the Plan of the Building as large as you can with Conveniency, and from the Middle of one Side, draw the Line O, to the

Center, and from one of the Angles draw the Line, Z, which will be the Line of Projection of the Angle Rafter, and, O, will be the Line of Projection of the Side Rafter, then take the Line, *a*, the Height you intend for the Roof, and ſet off at Right Angles, from one End of the Line, O, and Z, and draw the Lines *b*, *d*, to the Center, as you ſee in the Figure, and they will be the two Rafters; that is, *b*, will be the Side Rafter, and, *d*, the Hip or Angle Rafter. And if you would know the Lengths of the ſhort Rafters; make a Triangle, as, A *Fig.* 41. and let the Baſe be equal to one Side of the Octagon, Hexagon, *&c.* and the Sides equal to the Line *d*, and divide the Baſe, according to the Diſtance of the Rafters, and draw parallel Lines, as you ſee in the Figure; then make a Scale of the whole Breadth of the Building, (or any known Part) and that will give you the Length of any Part thereof.

PROBLEM XIV.

To find the Hip Rafter of an Ogee Roof. Fig. 42.

Theſe Sort of Roofs are very ſeldom made uſe of, unleſs it be for a Summer-Houſe, or ſome ſmall regular Building, whoſe Plan is a Square, a Hexagon, or ſome ſuch even ſided Figure.

Suppoſe, the Plan a Square, as in *Fig.* 41, firſt ſet out in the Middle of the Plan, the Square of the Necking you intend to have at the Top, and from thence draw the Lines *a*, *a*, which are the Lines of Projection of both Rafters, then from either End at right Angles draw the Lines O, O, for the Height of the Roof, and they will give you the Length of both the Rafters, which are repreſented by the dotted Lines, Z, Z, and from theſe you muſt ſtrike the Ogees of both Rafters, as you ſee in the Figure; that is the Side Rafter muſt be ſtruck from two Centers after the Common Method of ſtriking an Ogee; but the Angle or Hip Rafter (if you have a Mind to be very exact) muſt be ſtruck with a Trammel or String; for as all Ogees are Parts of Cylinders, their Miters will be elliptical; therefore the Hip Rafter muſt be conſider'd as the Angle Bracket of a Cove, whoſe Centers may be found, by *Chap.* III. *Prob.* iv. that is, take the Diameter of the Circle that form'd the Ogee of the Side Rafters, for the Conjugate Diameter, and the Diagonal of that Line ſquar'd, for the Tranſverſe: and ſtrike them out as the Figure directs, and that will be the Shape of the Hip Rafter exactly.

But as the Difference between an Ogee Hip ſtruck from an Ellipſis, and one ſtruck from a Circle is ſo very ſmall, they may both be ſtruck out the common Way for any common Buſineſs. And as all the Side Rafters, excepting one, will be but Parts of Ogees, they are to be conſider'd as if they were whole, and a certain Part cut off at the upper End, as the *Fig.* 43. A will direct, that is to take the ſhorteſt Line, *a*, in *Fig.* 42, for the Baſe of the Triangle A, then take the ſhorteſt Line Z, and ſet off at right Angles from the End of the Line, *a*, and let the longeſt Line, Z, be the Hypothenuſe, as in the Figure, and divide the Line, *a*, according to the Diſtance of the Rafters, then draw the Line *e*, equal, and parallel to the Line, *a*, and divide it into the ſame Number of Parts, and draw the Ogees, as you ſee in the Figure. And where the Miter Ogee, z, interſects the other, they muſt be cut off, and the lower Parts will be the Short Rafters, then make a Scale of any known Part of the Building, as directed *Prob.* xii. of this Chapter) and that will give you the Length of any Part of your Roof. As to the Back, or Bevel, of the Hip Rafter it may be found as before directed.

N.B. There are ſeveral other Sorts of Roofs beſides thoſe I have here given, which are often

ten uſed in Building, but as they depend on the ſame Theory, or at leaſt on ſome of the foregoing Problems, I think it would be of little Uſe to give any more Examples here, for if the Theory of thoſe I have already given, are rightly underſtood, it will naturally lead the Practitioner to find the Rafter, or any other Part of any Roof, let the Shape be what it will.

PROBLEM XV.

To ſtrike out the Ribs of a Scalene Coue, applied to the Top of a Malt Kilu. Fig. 44.

This Contrivance is very often made uſe of in the Country to carry off the Smoak, and ſteam off the Malt when its drying, and erected much after the Manner of the Figure B, the conical Part, A, is fixed on a Center to turn with the *Wind*, over the Figure B, which is a large round Funnel built directly over the Middle of the Malt Kiln. As to the Method of erecting the lower Part, B, I ſhall leave it to the Practitioner's own Judgment. But as the Top is a Mathematical Fignre it muſt require the Knowledge of Lines to perform it as it ſhould be, therefore I ſhall give a ſhort Demouſtration of the Figure A, by itſelf. This

Figure if continued quite round, to cover the whole Funnel B, and terminated in a Point at the Top, would be an elliptical Scalene Cone, but there being a Bit wanting at the Top it can only be the Fruſtrum of ſuch a Cone, that muſt have a Part left open, as E, to let out the Smoak. The Reaſon why 'tis elliptical is becauſe the Baſe, or Bottom, is oblig'd to be a Circle, otherwiſe it would not turn round, therefore the Ribs ought to be elliptical, and plac'd at right Angles with the Axis, or Middle Line O, which will be the ſtrongeſt Way and ſooneſt perform'd; for if they are put horizontal, as the dotted Lines, *b*, *b*, *b*, *b*, *Fig.* 45. which is the common Way; they will all be Circles. But then there is a great deal of Trouble to work them bevel, according to the back Line K; therefore to make them elliptical, will ſave moſt of that Trouble, and they may be ſtruck out by the following Method.

Firſt, Divide the Cone A, into what Number of Ribs you pleaſe, as they are repreſented by the Lines *u*, *u*, *u*, *u*, then ſet off the Space you intend to leave for the Smoak, as the Line E, then from the ſame Baſe, draw the Fruſtrum of the upright Cone, D, *Fig.* 46. and divide it into the ſame Number of Ribs parallel to the Baſe, then to ſtrike out the firſt Rib take the Line *n*, in the Figure D, for the Tranſverſe Diameter of the Ellipſis, *Fig.* 47. And the Line *u*, next the Baſe in *Fig.* A. for the Conjugate Diameter, and proceed to ſtrike out the Ellipſis, as directed *Chap.* II. Then take the ſecond Line *u*, next the Baſe, for the Coujugate Diameter of the Second Rib, and diminiſh the Tranſverſe in the ſame Proportion, that is let the Center Pins of your Trammel remain the ſame Diſtance one from the other, as before, and ſtrike the Ellipſis *a, a, Fig.* 47. which will be the Second Rib; and by the ſame Method ſtrike out the Reſt, as the *Fig.* D, will direct, and as to that Part of the Ellipſis, which will be for Uſe, they may be diſcover'd by cutting off as much of every Conjugate Diameter of the Ellipſis, as the Line E, in *Fig.* 44, cuts off from each Rib, and as the dotted Lines *Fig.* 47 directs.

PROBLEM XVI.

To ſtrike out a Saſh and Frame, with a circular Head and Front, for a circular Building, with Directions how to work the ſame. Fig. 48.

Theſe Sorts of Windows are not very often made uſe of in Building, but where the Founder doth not value the Expence, and if they are well introduc'd, they muſt certainly appear with a noble Grandeur, and render a Building very magnificent. It muſt be allowed, that ſuch a Piece of Work is very difficult to perform, and muſt require a good Hand, that hath been us'd to Compaſs Work to undertake it. But was I to perform the ſame, I ſhould proceed in the following Manner.

Firſt, To find the Center of the circular Part of the Building, and draw the Plan of the Saſh Frame, B, which is repreſented by the Sill D, then make three Molds, one to the Inſide of the Saſh-Frame, another for the Inſide of the lower Saſh, and the third for the Inſide of the upper Saſh; then glew up a Board by the firſt Mold, as large as the whole Frame, and there on the Convex Side draw out the whole Saſh and Frame, as may be ſuppos'd like the Figure 49, G. But here it is to be obſerv'd, that in drawing out the circular Head of the Saſh and Frame, if the Center was a Semicircle that turn'd the Arch in the Building, it will not be ſo on the Compaſs-Board you draw on, for if you endeavour with a Pair of Compaſſes, from one Point, to ſtrike a Circle on a Cylinder, it will be an Ellipſis in Plano, and from the ſame Reaſon an Ellipſis may be ſo proportion'd, as to be a Circle when taken off the

Cylinder, which may eaſily be done, by covering it with Paper and taking it off when ſtruck out, and laying it on the Plane. From hence 'tis plain, that the Lines for the Head of the Window G, when drawn on a Compaſs-Board that is Part of a Cylinder cannot be ſtruck from one Center, but muſt be elliptical, whoſe Diameters may be found by Girting over the Compaſs Board with a Line, as far as the Width of the Saſh Frames, and that will be the Tranſverſe Diameter repreſented by the Lines, O, O, in the Figure G, that Line muſt be laid down on a plain Board, then take the Line, *á*, in the Figure, *n Fig.* 50. for the Conjugate, and place it at right Angles from the Middle, and by *Prob.* vii. *Chap.* III. find out the Center to ſtrike the Ellipſis with a String, and ſet off thoſe two Centers on the Line O, O, in Figure G, and there fix two Nails and with a String ſtrike out the Arch *m*, and by ſetting off proper Margins, the whole Head of the Saſh and Frame, may be ſtruck out by the ſame Center. This being done, compleat the whole Window by drawing every Part in its full Proportion.

Then begin to work the Head of the Saſh Frame, by fitting of ſolid Pieces (that are thick enough and wide enough for the Head of the

Frame, Beads included) ſo as to make a Joint to the Compaſs-Board, or Mould, you work on, according as the Lines direct; and from the under Side ſo fitted, gauge them to their proper Thickneſs, and mortiſe and tenent them together (as you ſee in the Figure) according to the Number of Pieces, obſerving to let the ſolid Part come low enough to receive the Pully-Pieces and Frames, which may be let in Fluſh, and nail'd to the ſame. The Head being thus prepar'd and pin'd together, lay it down on the Board where it was firſt fitted, and fix a Piece of Wood of the ſame Thickneſs over the Centers at *a*, and transfer thoſe Centers before given to the Top of the Piece ſo fix'd, and let them be a ſmall Matter wider aſunder, by Reaſon this upper Side of the Saſh Frame muſt be wider than the lower Side, to anſwer the Splay of the Pully-pieces, which ought to point to the Center of the Building, according to the firſt Figure D. The Head of the Frame being work'd according to the given Arch; gauge off the Beads; rebate the Space between (which is the Thickneſs of the two Saſhes,) and ſtick the Beads, and the Head will fit the Arch propos'd.

The other Part of the Frame being not very difficult to perform, needs no Direction here therefore the next Thing I ſhould do, would be, to take the ſecond Mould (which is the Inſide of the lower Saſh) and fix the Compaſs Board to the ſame, by ſetting it a little wider with two Braces underneath, untill it become flat enough to fit the Mold. It being thus fix'd begin the lower Saſh, which may be bent (if the Curve is not too quick) in three Parts, after the common Way of performing ſuch Work the upper Saſh may be work'd after the ſame Manner, (when the Compaſs Board is ſet to the third Mould as before directed) excepting the Semicircle Part, whoſe Curves being of a Compound Nature cannot be bent in Thickneſſes, therefore I ſhould chuſe to bed the Rail and Spandrels after the Manner as before directed for the Head of the Saſh Frame.

CHAP.

CHAP. V.

Of the Nature and Properties of Arches, ſhewing what Shape are moſt durable, and capable of ſupporting the greateſt Weight, with ſome Remarks on the intended New Bridge *at* Weſtminſter.

BY the Word *Arch*, we are taught to conceive the Idea of ſome regular Curve, or crooked Line, as the Line, A, *Fig.* 51. which when applied to Practice in Building is always put with the Convex Side uppermoſt in order to ſupport ſome Weight, as the Fig. D. But without the Butments, *e*, *e*; (if it was in Parts as Building requires) it would not ſupport itſelf, for the Action of Gravity preſſing upon it, would ſoon tumble it down: And was it a flexible or malleable Body, would ſoon reduce it to a ſtreight Line.

From hence 'tis plain, that the Strength of all Arches depends upon the Butments, and that

Dependency is in Proportion to the Height they riſe from the Chord Line of their reſpective Arches, which Line is repreſented by the Line A, in *Fig*. D.

The Truth of this will very plainly appear by ſetting up two Sticks (or Pieces of Wood in the Shape of Leavers) one againſt the other on a Plain Board, in the Nature of a Pediment, as the Lines *o*, *o*, *Fig*. 52. and *a*, *a*, *Fig*. 53. in the Arches, A and B. I ſay, the Pediment *o*, *o*, requires a greater Weight, or reſiſting Power, to be plac'd at the Foot *e*, *e*, to keep it from falling, than the Pediment *a*, *a*, therefore the Arch B, will conſequently ſupport a greater Weight than the Arch A, if their Butments are equal. The Reaſon of it is the Lines *a*, *a*, are nearer a Perpendicular than the Lines *o*, *o*, for if thoſe before mention'd Pieces of Wood, were plac'd perpendicular one againſt the other, with a Hinge at the Top, and Wheels put in the Bottom for the Sake of Experiment to take off the Friction; they would in that Poſition, want no Butment to keep them together at Bottom, but if they are a ſmall Space aſunder at the Bottom, they will want a Butment to keep them in that Poſition, otherwiſe they will run one from the other, and the further they recede from each other, the greater muſt the reſiſting Power, or Butment be, to keep them from falling.

From what hath been ſaid it appears, that Gravity acts on thoſe two Leavers, according as they are elevated or depreſs'd; and if ſo it muſt be in ſome Proportion; which Proportion may very nearly be determin'd by the following Figure G, *Fig.* 55. whoſe Theory depends on that of the Steel Yard; which for the better Underſtanding of what is to follow, I ſhall endeavour to explain, by the next *Fig.* 54. E. Let the Line *c* and *o*, repreſent the Beam, and *o*, the Center of a Pair of Steel-Yards, and ſuppoſe two Weights, as, *n*, and *r*, were to be hung at equal Diſtance from the Center, O, and the other Part of the Beam cut off, they would then hang in Equilibrio, that is, *n* and *r*, would be equal. But if the other Part of the Beam was to be added, and the Weight *n*, was carried on the Beam, as far as the Figure 10, and ſuppoſe the Weight was but one Pound each, then I ſay that the Weight *r*, muſt have Nine Pounds added to it to make it ballance the Weight *n*, when remov'd ſo far from the Center. But here 'tis neceſſary to obſerve, that in making thoſe Inſtruments, the Weight that is occaſion'd by the Length of the Beam is always account-ed for before they begin to divide, and 'tis very eaſy to diſcover what Weight did belong to a Pair of Steelyards, ſuppoſing it to be loſt) by taking the Diſtance between the Centers of the Hooks, that is between O, and *r*, and apply it to the proper Edge, and the Diviſion there will tell you what the Weight ſhould be, for it is that Diſtance multiplied into the whole Length, as you may ſee in the Figure. But here in this preſent Caſe the Beam is only imaginary, for it is the Diſtance from the Center, that Occaſions all thoſe different Gravitations, for if we ſuppoſe the Circle, *a*, *b*, *c*, *d*, to be a Wheel, and, *o*, its Center, and a Weight of one Pound to be fix'd at its Periphery at *b*, and the Wheel to be turn'd round, the Weight when it is got to *e*, it will be 3 Pounds, and at Z 5; and the Gravitation of ſuch a Weight will increaſe in the ſame Proportion, as if it was carried along the Beam, *e*, as you may ſee by the Diviſions. By this uſeful Inſtrument may alſo be diſcover'd the Power of the Leaver from a Perpendicular to a horizontal Poſition, and may very juſtly be call'd a Scale to meaſure all mechanick Powers that act from Centers, and notwithſtanding our preſent Subject be two Leavers ſet up one againſt another, yet I believe the next Figure will make it appear

very

very plain, that they alſo depend on the ſame Theory, and are ſubject to the ſame Laws of Gravitation. For as thoſe two Leavers, *a*, *a*, in *Fig*. 55. G. ſupport one another at the Top, and prevent their falling or acting like Leavers; yet, I conceive that Gravity will act on the Bottoms (when the Friction is taken off by Wheels) in the ſame Proportion, as if they were turn'd End for End, according to the Left Hand Side of the Figure G, when turn'd upſide down, that is to put the confin'd End downwards, and let the upper Ends fall one from the other. I ſay in the Fall of ſuch a Leaver, the Gravitation would be increas'd in the ſame Proportion as is there ſet down. For if the Leaver *a*, by falling from the perpendicular Line G, ſhould have gain'd a Force of one Pound, it would at *e* have gain'd three Pounds at *z* 5, and ſo on in Proportion, as was gain'd by the Weight at the Periphery of the Wheel in *Fig*. E, until it becomes horizontal. In the ſame Proportion I conceive Gravity to act at the Bottom of the two Leavers *a*, *a*, that is, if at *a*, they ſhould want a Butment of one Pound at each Foot to keep them in their Poſition; at *e* they would want three, and at *z* 5, and ſo on in the ſame Proportion as they are ſet down in the Right Hand

Side of the Figure G, until they become ſo far extended as to lie level on the Plane they moved on; from what hath been demonſtrated from *Fig.* G, it is plain that Gravity acts on Pediments, according as their Sides are elevated or depreſs'd: And if ſo it muſt certainly act on all Arches in the ſame Proportion, as their inſcrib'd Pediments are to one another in Reſpect to their Height. And from hence may be diſcover'd how much Weight one Arch will bear more than another, that is the ſame Width, and hath the ſame Butments to ſupport it. That is, if the lower Arch, in *Fig.* D. 56. will bear 500 Pound Weight, the Arch *a*, will bear 600, and the Arch *b* 700, and ſo on according to what Height you riſe; may the Weight be increas'd, which will always be in Proportion as the Sides of the inſcrib'd Pediments are to one another, when their Chord Lines, or Widths, are the ſame, as you ſee in the Figure.

Notwithſtanding I have given this Method to ſhew how much one Arch will bear more than another of the ſame Width and Butments, yet I do not pretend to know, how much Weight any Arch will bear, for there is no Arch that I know of, that can be ſaid to bear all the Weight that is built perpendicular over it ; becauſe that Part hath Communication with Reſt of the Building, and cemented to it in ſuch a Manner that takes off a conſiderable Part of the Weight that would otherwiſe preſs upon it, if that Communication was deſtroy'd. And I may venture to ſay, that it is from this Reaſon, that Arches ſometimes become ſo looſe that their Key Stones are almoſt ready to drop, for Want of a ſufficient Weight, to keep their Parts together.

From this Obſervation it is plain, that all Arches want a Weight proportionable to the Height they riſe to keep their Parts firm in the Situation they are firſt plac'd, for it is very reaſonable to think that the Arches of *London* Bridge would not have remain'd ſo intire to this Day, if it was not for the Weight of Houſes that are erected thereon, which muſt certainly prevent thoſe frequent Shocks and Shakings that it muſt otherwiſe have ſuffer'd by loaded Carts and Carrs, and other Vehicles of Burden that daily paſs and repaſs thereon.

But whether the intended New Bridge is to have any ſuch, I know not, or whether the Ground Rents of ſuch Houſes would be equivalent to the Expence of making the Bridge ſo much the wider, I will not pretend to determine altho' I believe, that the Revenues ariſing from thence would be very conſiderable.

But to proceed, to make ſome Obſervations on the Shape of Arches, in Reſpect to their Duration.

I think the moſt common Sort that are to be found amongſt our Modern Buildings are either Semicircles, Segments, or Semi-Ellipſis, which I muſt own have an agreeable Effect on the Eye, becauſe they are Part of Regular Figures, and make a good Appearance in a Building, if they are well proportion'd, and well introduc'd, but this is not always obſerved by our Modern Builders, for I have often ſeen a Paſſage of three Foot wide with a Semicircle Arch, and a Gateway of ten, with an elliptical one, whoſe Height from the Springing hath not exceeded twenty Inches; ſuch a one cannot be ſuppoſed to be of any long Duration, without very ſtrong Abutments, unleſs the Weight be diſcharged by a concealed *B*reaſtſummer, or very little laid thereon. In ſuch Caſes, Ornament is conſulted more than Strength for the Arch of three Foot being a Semicircle will bear above ten Times more Weight than the elliptical one of ten Feet, with the ſame Butments by Reaſon of its Flatneſs, and double

Centers, which muſt render it very weak and unfit to ſupport a great Burthen. I mean ſuch Ellipſis whoſe tranſverſe Diameter is plac'd horizontal, as B, *Fig.* 57. but if you take an Ellipſis the other Way for an Arch, and let the Conjugate Diameter be horizontal, as A, then it will become altogether as ſtrong, and may very juſtly be eſteem'd the beſt Sort to ſupport a great Burthen, excepting thoſe formed by the Catenarian, which I ſhall endeavour to prove (before I leave this Subject) the ſtrongeſt of all and moſt durable. But for the Truth of what I have aſſerted in reſpect to the elliptical Arches A and *B*, I muſt refer the Reader to a very eaſy and familiar Experiment, which is to take an Egg (whoſe Shape is near enough for the Purpoſe) and try whether it will not bear a great deal more Weight on the Ends than it will on the Sides before it burſt, ſuch an Experiment ſeems to me to put this Matter out of the Reach of Contradiction, and will juſtify the Theory that I have hitherto endeavour'd to explain. Namely, that all Arches will bear a Weight proportionable to the Height they riſe from their Springing, if their Chord Lines, or Openings, are the ſame, let the Shape be what it will altho' it muſt be allow'd that ſome Sort of Shape will bear more Weight than another of the ſame Height and Butments, for if the elliptical Arch B was a Segment of a Circle of the ſame Height, it would add much to its Strength by Reaſon that Curve would be more uniform and approach nearer to a Catenarian than it was before in that flat elliptical Form, for it is my Opinion, that the Strength of all Arches would be increaſed the nearer they approach that firm Arch of Nature, for ſo I muſt call it, by Reaſon it is form'd by Action of Gravity, which muſt be allow'd to be a natural Cauſe.

This Curve, or Arch, may be diſcover'd by ſuſpending a Chain, or flexible Line (that is not very light) from two horizontal Points, or Nails, as *o*, *o*, in *Fig.* 58 D, the Curve, or Arch, that ſuch a Line, or Chain, will form, is call'd a Catenarian, repreſented by the Line *a*. This Line, as I before obſerv'd, is form'd by the Action of Gravity, which acts on all Bodies, according to their Denſity, or Quantity, of Matter they contain, if their Form and Shape are the ſame; therefore, if Gravity by its Action on a ſlack Line, or Chain, forms the Arch *a*, it is very plain, that if it were turn'd upſide down it would form the Arch K, which conſequently muſt reſiſt that Action in the ſame Proportion, as the other gave Way, that is K would become an Arch of equal Strength in all its Parts, and for that Reaſon muſt certainly be the beſt Shape for any Arch that is to bear a great Burthen.

But, as the Properties of the Catenarian Arches are ſo far conceal'd that it would be very difficult to aſſign any Centers that would ſtrike the ſame, for if they are very flat they appear like Segments of large Circles, but if you endeavour to form a Semicircle by letting the Line drop half its Opening, it will then appear elliptical, and as you drop it lower it ſeems to approach the Hyperbola, ſo that the diſtant Appearances it makes in theſe different Stations muſt render it very difficult to find out proper Centers to ſtrike them out.

But for thoſe that have Occaſion to apply them to Practice may obſerve the following Method, and may anſwer the Purpoſe very well, if it be carefully obſerv'd, that it is to take ſuch a Line (as beforemention'd) and rub it with Chalk, or Charcoal, until it be fit to leave an Impreſſion then on ſome flat Plain or Board (that is large enough for the Uſe) fix in two Nails horizontally, according to the Width of your Arch, and from thence let the Line fall as far below the horixontal Line *a*, in *Fig.* G. 59. as you would have the Arch to riſe above it, then carefully preſs the Line hard enough to leave the Impreſſion, and that will be the Arch required as *n*, then move the Nails from *o* to K, according to the Margin you intend to ſhow in the Front, and from them let fall the Arch *m*, and that will limit the Border, or Margin, which may be divided and Mould made to fit the Curve in the ſame Manner, as if the Arch was in any other Form, as you may ſee in the Figure, which in Practice muſt be turn'd upſide down; but, as I obſerved before, that the lower the Line was let fall the nearer it approach'd an Hyperbola, therefore it cannot be expected that the Lines *n*, and *m*, will be parallel or appear concentrick like Arches ſtruck from the ſame Center, but for thoſe that ſhould think it appeared diſagreeable for the Margin of an Arch to be wider at Top, as *Fig.* G. may eaſily prevent it by making the Moulds parallel to the inward Arch *n*, which would be a Matter of Indifference in reſpect to its Strength.

But notwithſtanding all thoſe diſtant Appearances before-mention'd that are made by the Catenarian Line, yet I cannot help thinking, but that they are all of the Hyperbola Kind; for as the Hyperbola is that Section of a Cone cut any where when parallel to its Axis, I ſay it is no hard Matter to imagine a Cone large enough that will admit of the flatteſt, as well as the higheſt Arches to be cut off by ſuch a Section; now, I believe it will appear from what I have already ſaid on this Subject, that Catenarian Arches are the beſt Shape for Duration, and for that Reaſon the moſt proper Form for the New Bridge on the River *Thames*, if it be built with Stone. But be it as it will, I think the Foundation ought to be of Stone, as far as High Water Mark, and conſidering the Depth of the River muſt require ſome Contrivance to lay the lower Stones, and fix a Baſement in Water firm enough to ſupport ſo heavy a Weight that muſt conſequently depend thereon.

As to the Laying the Foundation, which is commonly built in Coffer-Dams, and which are carried to their proper Places in the River, and the Foundation there begun, and carried on in thoſe, obſerving as the Foundation ſinks to make good their Out-Work, to keep out the Water, and ſo work on untill the Pier is got above the Surface of the Water. This Method is practic'd abroad, where Buildings of this Nature are more common, and may do very well where the Piers are ſmall: But I cannot apprehend how ſuch a Method can be practic'd with a good Effect in the River *Thames*, where the Tide is conſtantly ebbing and flowing, and the Piers very large and heavy; neither am I able to conceive how a Foundation of that Nature can be well laid and ſecured where the Workmen have not firm Ground to work on, but altho' I cannot foreſee the good Effect of ſuch a Proceeding. This Method may be practicable, and may (for ought I know) be the only one intended to execute the Deſign of the Bridge. But if it be ſo determin'd, I hope it will be no Affront to thoſe Gentlemen concern'd, if I offer another that (according to my Notion of Things of this Nature,) will do as well, if not better, if it it be not thought too expenſive, which is to circumſcribe the Place in the River where the Piers are to ſtand with the Piles and Planks duff-tailed and grooved together and ſharpened and well ſhod with Iron fit to drive into the Bottom of the River in the Form of the Plan B, *Fig.* 60. the Length of thoſe Piles and Planks muſt be determin'd by the Depth of the Water, allowing for that Part that is to go into the Foundation. The Subſtance of the Piles ought to be ſubſtantial. The Thickneſs of the Plank about 6 or 8 Inches, and the Piles to be drove in about four Foot aſunder, and

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the Planks between, and ſo on till the whole Range be compleated. Such a Range of Piles and Planks may be too weak to reſiſt the external Preſſure of the Water, and if ſo, they may eaſily be ſtrengthened by driving in other Piles along the Outſide, about four or five Foot from ſome of the others that belong to the Range, and brace them with diagonal Braces, and that will be a Security againſt the external Water and prevent it, puſhing it down when the internal Water is all pump'd out. And if the Grooves (which ought not to go ſtiff) were dreſs'd with Greaſe, or Tar, or ſome ſuch Matter, it will make them drive the better, and be a Means to prevent their Leaking, not as it can be ſuppoſed that ſuch a Fence will be without any. But I cannot apprehend, that there will be any Leaks ſo large, or numerous, but they may be diſcharged by Chain Pumps, and the Place kept dry enough for the Workman to lay the Foundation, as well as if there was no River to interrupt them : This Method ſeems to me to be more agreeable to the Nature of the Deſign, than the former one before mention'd ; but as I can give no Precedent of any Proceedings of this Nature, I muſt leave the Publick to judge of the Effect. At the Place where the Bridge is to croſs the River, Care ought to be taken, that it be where the Stream hath a direct Courſe, and the Bridge to be built at right Angles to the Stream, otherwiſe it will render the Paſſage for Boats and Barges more dangerous and difficult to paſs and repaſs than if the Stream run parallel to the Sides of the Arches.

This I muſt own is a plain Obſervation, but very neceſſary to be obſerv'd by thoſe that are intruſted to ſet out the Place where the Bridge is to croſs the River.

Here I intended to have finiſh'd this Subject, but ſeeing two Pamphlets publiſh'd, the one being a Deſign for the Bridge, the other a Reply to Mr. *James*'s *Review*, by which I am inform'd, that not only one Mr. *Langly*, but ſeveral ingenious Gentlemen have ſome Time ago publiſh'd their Deſigns and Calculations relating to this new intended Bridge, which had I known before (it is very probable) would have prevented my ſaying any Thing about it. But as their Views in publiſhing ſeem different from mine, and I have unwarily enter'd upon this Subject, I ſhall venture to go on with it a little further, not as I would willingly enter into that Controverſy that hath been ſo warmly diſputed amongſt thoſe that would have their Schemes perform'd. But what I intend only to make ſome few Remarks on what I have ſeen, which will render the Subject on Arches the more compleat, and may chance to give this Performance a better Taſte to the Publick.

Mr. *Langley*, in the Beginning of his Deſign for the Bridge, hath taken a great deal of Pains to eſtimate the Fall of Water that will be occaſion'd by a Bridge being built over the River *Thames*, either at the *Horſe Ferry*, or at *New Palace Yard*, and in his Reply to Mr. *James* hath beſtow'd ſeveral Pages in the Vindication thereof.

But, ſuppoſing this new intended Bridge ſhould occaſion a Fall of Water that will be an Inch or two more or leſs than Mr. *Langley* would have it to be, or that it will be High Water between the two Bridges before it is above the New One, ſeems to me to be a Matter of no Conſequence, ſince it muſt be allow'd by all that know any Thing of the Matter, that the New Bridge will not occaſion any material Difference in the Height of the Tides in general, but that they will flow to the ſame Height as uſual.

I think ſuch Niceties as thoſe may be conſider'd but as Trifles in Reſpect to the principal Deſign, which is to erect a Bridge over the River in the moſt expeditious Manner and to be both convenient and durable, how far theſe Deſigns and Direction propos'd by Mr. *Langley* and others are likely to anſwer the End, I ſhall not venture to enquire.

As my chief Deſign is to demonſtrate the Nature and Property of Arches. I ſhall begin my Remarks on theſe deſign'd by Mr. *Langly*, which being of the Catenarian Kind (as I have before obſerv'd) are the ſtrongeſt of all other, and for that Reaſon, the moſt proper to apply to a New Bridge over the River of *Thames* if they are well proportion'd, and had Mr. *Langly* but deſign'd them lower or laid a greater Weight (or Thickneſs) on the Crowns of thoſe he hath there given, I ſhould have thonght it more conſiſtent with the Nature and Property of ſuch Arches whoſe Height is more than half their Opening, for it hath before (in *p*. 49.) been demonſtrated that all Arches will bear a Weight (on their Crowns) proportionable to the Height they riſe, if their Abutments are the ſame, and if they will bear it, it is plain they want it from the following Obſervation that may be made of a common Tub or drinking Veſſel which may very juſtly be ſaid to have the ſame Properties of an Arch, for the Staves may be conſider'd as ſo many Stones whoſe Joint Point to one common Center, and the Hoops that circumſcribe them as their Weight or Preſſure then I think it cannot be deny'd by any Perſon (of common Underſtanding) that the tighter thoſe Hoopes are drove on round ſuch a Veſſel the more compact it muſt keep the Staves and the ſtronger the Veſſel will be for ſuch a Weight or Preſſure therefore it appears to me, that Weight on an Arch will have the ſame Effect as a Hoop hath on a Tub if the Weight be well proportion'd.

But in order to give my Opinion in this Affair the Actions of Gravity on ſolid Bodies ought to be underſtood and the Shape of the Arch well conſider'd before a Man can form any Judgment about the Weight it will carry, or on what Part to beſtow it to the beſt Advantage, therefore for the better underſtanding what is to follow on this Subject. I ſhall venture to lay down the following Theorems,

I. When any Weight preſſes on the Sides or Haunches of an Arch the Weight on the Crown muſt be conſider'd as an Abutment to that Weight on the Haunches and in Proportion to the Height they riſe from the Cord Lines of their reſpective Segments, will the Weight on the Crown be required.

II. And as the Weight on the Crown is an Abutment to the Weight on the Haunches ſo is the Weight on the Haunches an Abutment to the Weight on the Crown.

III. And as the Weight on the the Haunches wants to reduce the Curvature thereof to a ſtraight Line, contrary to that, doth the Weight on the Crown want to make it riſe higher or puſh it out at Foot if there is no Abutment plac'd there to prevent it, and both would produce that Effect if it was not for a Counter-Ballance of Power as will be beſt explain'd by the following Figure.

As I have *p.53.* propos'd a Method in order to diſcover how much Weight one Arch will bear more than another that hath the ſame Extent and with the ſame Abutments, I ſhall here conſider what Effect the Weight on the Haunches hath on Arches of different Shape, thisMethod is built on the ſame Theory as the Former and to ſave the Reader the Trouble of turning back (as the Figure is nearly the ſame) I ſhall explain it thus:

If the Segment Arch, *a*, *e*, *e*, fig. *61*. will bear 5 Hundred (or a Tun) Weight the Semi-circle, *a*, *b*, *c*, will bear 6 Hundred with the ſame Abutments, and the Cartinarian *a*, *d*, *c*, will bear the Weight in reſpect to the Abutments below but if they are both conſider'd as having no Weight on their Haunches, the Cartinarian muſt be the ſtrongeſt, by reaſon of the Curvature of its Haunches are nearer a right Line than thoſe of the Semi-circle for was there as much Weight laid on the Crown of the Catenarian Arch as it would juſt bear the ſame Weight if apply'd to the Semi-circle would occaſion it to burſt out and fall down, which plainly ſheweth that the Semi-circle wants a greater on its Haunches to Counter-Ballance the ſame Weight on the Crown, and how much more Weight is required on the Haunches of the Semi-circle to counter-ballance the ſame Weight on the Crowns of both may be (nearly) diſcover'd by the ſame Method, for by drawing the Cord Line *o*, will cut off one Haunch of both which may be conſider'd as whole Arches and the Difference of Weight be diſcover'd in the ſame Manner for if the Haunch of the Catenarian requires nine hundred Weight the Semi-circle will require Ten, to enable it to ſupport the ſame Weight on the Crown as the Catenarian and the Haunch of the Segment *a*, *e*, *c*, is likewiſe ſubject to the ſame Rule, and requires but ſeven, by Reaſon the Haunch is not ſo much elevated which gives the Weight a greater Gravitation.

In like Manner may the Difference of Weight be diſcover'd in any two Arches, which will always be in Proportion, as the Chord Lines of their reſpective Segments are to one another, or in Proportion, as the Sides of their inſcrib'd Pediments are to one another, which implies the ſame Thing as may be ſeen by the Figure.

In *P.* 50 and 51, the Reader may find I have there explain'd the Nature and Property of the Steel-Yard, and in the next Page have made uſe of its Power, to diſcover what Power a Leaver gains by falling from a Perpendicular to a horizontal Poſition, and likewiſe to prove that all Arches want an Abutment proportionable to the Height they riſe, and as that anſwer'd the Purpoſe ſo far as to appear to me a Demonſtration, I ſhall introduce the ſame Power, and by it examine Mr. *Price*'s Middle Arch, in the Manner following, *Fig.* 62.

Let A, B, C repreſent the Arch propos'd, now if we ſuppoſe, that the half Arch B, C, was in one Stone, and its Weight 28 Tun and a half, and that it was by ſome Power to be lifted upon its Pier *w*, until it come to its Center of Gravity, which may be ſuppos'd to be at *d*, then it is very plain, that the Pier muſt bear all its Weight, and if from thence it was to be let down to a horizontal Poſition, as at *x*, and a Support put under the End, as at *o*, the Support *o*, would bear 14 Tun and one Quarter, and the Pier *w* would bear the ſame Weight, and was it from thence to be lifted up to its proper Place at B, and there ſupported, then will the Pier *w*, bear 20¼ Ton, and the Support at B, bear 8¼ Ton, for the End B, being elevated, the Support *o*, is releas'd of 6 Ton Weight, which conſequently muſt be added to the Pier; for as this half Arch is ſuppos'd to be in one Stone, it may be conſider'd as a Leaver, and be ſubject to the ſame Laws of Gravitation, as hath before been demonſtrated, and may be explain'd by this Figure.

This Method ſeems to me to give ſome Inſight, whereby the real Weight of the Abutments may be diſcover'd; for if the Support *o*, was taken away, and the other half Arch A, B, was ſet up againſt it in its proper Poſition, that muſt certainly throw the whole Weight of both on their reſpective Piers, but as A, B, is ſet at the ſame Angle, as B, C, they would thruſt each other down, if there was not an Abutment plac'd at A and C, to prevent it. Now, if we conſider, that before A, B was ſet up againſt B, C, the Support *o*, ſupported 8 Tons and a Quarter; therefore the Thruſt of A, B muſt be equal to that Weight, if there was no Friction at *c*, and if ſo, it appears very plain to me, that a Weight of 8 Tons and a Quarter, plac'd at A, and at C, will be a ſufficient Abutment for the Arch, A, B, C; for as ſuch a Weight is a counter Ballance to the Thruſt there will be the Friction of A, B, C, on the Piers for a further Security, which, conſidering the great Weight of A, B, C, may, perhaps, be equal to two Ton more, but this muſt be refer'd to Experiment.

And, if the Arch A, B, C was to be conſider'd in Parts, as the Half A, B, the Weight or Preſſure, would ſtill be the ſame, for by drawing parallel Lines from the Joints to the Chord Line plainly ſheweth how the Weight is diminiſh'd, as appears by the Figure.

By what I have endeavour'd to demonſtrate, it appears very plain, that the Center which is to ſupport the Arch, A, B, C, will be releas'd of 12 Ton Weight, in the Thickneſs of the whole Breadth, which is ſuppos'd to be 40 Feet, and the Number being multiplied by 12, the Produce is 480, which being reducted out of 2320 (which is ſuppos'd to be the Weight of the Whole) the Remainder is 1840, which will be nearly the Weight (when that of the Key-ſtone is deducted out) that will lie on the Center before it can be reliev'd by the Key-ſtone. How much of the Spandrel's Weight will preſs on the Arch is very difficult to diſcover, becauſe it hath a Communication with the upper Pier, or Breaſt-work, which takes off a great deal of the Preſſure, but was that Communication to be deſtroy'd, and it was to be conſider'd as one Stone, and to have no Friction on the Arch, it could then be only ſaid to lean on the Arch, and what Weight that Leaning is may in ſome Meaſure be diſcover'd by the ſame Rule as the former; that is to draw a Line, as *d*, (in the 62d Figure) in ſuch a Manner, that if the Spandrel was lifted up on its lower Point until that Line become perpendicular, it would then be the Center of Gravity, and if the Line *d*, was continued to cut the Arch P, and from thence let fall a Perpendicular to the Chord Line, which if divided according to the Weight of the whole Spandrel, it will give the Weight that will preſs on the Arch if the Line *d*, be ſo drawn as the Quantity of Matter on both Sides are equal, which ought to be regarded in the half Arch, B, C, as well as in this preſent Caſe.

I ſhould not have applied this Power to the Spandrel had it not been to have ſhew'd the Extenſiveneſs of this Method in Reſpect to Arches as well as to other mechanical Operations, not as I will pretend that this Method will diſcover exactly the Weight, or Preſure, of any Arch, but I believe it will be near enough to let a Man know what he is about when he either deſigns or erects one.

But, as the Spandrel will be work'd up with the Upright of the Pier and cramp'd and cemented together, and the Joints diſpos'd of in ſuch a Manner as will take off moſt of its Preſſure, unleſs it be thoſe Stones near the Crown, which have no Occaſion to be laid on until the Key-ſtone is fix'd, and I cannot help thinking, but that it may be fix'd before the Spandrels are begun,provided it have a Bearing on the Center, eſpecially in thoſe Sort of Arches that are of the Catenarian Kind, whoſe Haunches, I dare ſay, would ſuffer no Diſturbance, if the Key-ſtone had a Bearing on the Center.

If this Arch will admit of being work'd up after this Manner there is no Occaſion to allow any Weight for the Spandrel, ſo that then there will be no more Weight to account for (that will lie on the Center) than that of the Arch itſelf, which, according to this Way of Demonſtration, will be no more than 840 Tons, which is ſeveral Tons leſs than ſome Men have imagin'd will lay thereon.

As this Center muſt be forty or more Feet long, I do not ſee any Reaſon to double it, it being able to ſupport the Arch, if the Weight of it was as much more; for if the great Length be conſider'd in reſpect to the Weight, the Weight muſt appear but inconſiderable in regard to the Weight that ſuch a Center may be made to bear, and if the Centers are made with Judgment, and allow'd a firm Foundation, or Bearing, at the Springing it is unknown what a Weight ſuch a Center will bear.

From what hath hitherto been endeavour'd to be demonſtrated, in Reſpect to Arches it appears to me, that their Strength doth not ſo much depend on their Shape, as the Weight they bear, being well adapted thereto; for altho' it muſt be granted, that Catenarian Arches (if conſider'd as independant of any Weight but their own) are the ſtrongeſt of all other, yet if the Weight on their Crowns is not proportionable to the Height they riſe; they may be ſaid to be weaker than a Semicircle, or Arches, of any other Form, if their Weight and Abutments are well proportion'd, and if I may be allow'd to give my Opinion on thoſe Arches, deſign'd by Mr. *Langly*, Mr. *Price* and Mr. *Hawkſmoor*, (which are all I have ſeen that are deſign'd for the Bridge) I muſt give the Preference to that deſign'd by Mr. *Hawkſmoor*, for notwithſtanding the Shape is a Semicircle, the Weight ſeems the beſt proportion'd and the Nature of the finiſhing the beſt adapted to the Situation; but, however that be, it cannot be denied, but that the Arches in either of the Deſigns (if well executed) would ſupport a Bridge over the *Thames*, but then I think it would have been to a better Effect if they had been allow'd a greater Thickneſs of Building over their Crowns, which according to my Way of Thinking they all ſeem to want, eſpecially thoſe deſign'd by Mr. *Langly*, which by Reaſon of its Shape are beſt able to ſupport it, and had he but allow'd a greater Thickneſs between the Crown of his Arches and the Paving of the Bridge, it would conſequently have added a greater Weight, which, in all

Probability, would have prevented that unequal Preſſure occaſion'd by the Declination of the Bridge from having a bad Effect on the Arches, which in order to prevent hath leſſened the Weight on the Haunches by cylindrical Vacuities proportionable to the Difference of their Preſſure, which is monſtrouſly abſurd.

But this I conceive Mr. *Langly* hath introduc'd through Ignorance; for had he conſider'd, that the Weight on the Haunches is not ſo great as it appears to be, and that what is, may be conſider'd as an Abutment, he could never have imagin'd, that the Unequalneſs of their Preſſure would occaſion their becoming rampant and falling down, if the next adjoining ſhould chance to be remov'd by either Time, or Accident.

I ſay, if he had laid a greater Weight on the Crowns of thoſe Arches he deſign'd for the Bridge, and omitted thoſe cylindrical Vacuities he hath there introduc'd, his Arches would then have appear'd to me more capable of Duration, and this he might eaſily have perform'd; for if the Surface of the Bridge would not admit of being carried any higher the Arches might have been made lower, and by that Means have gain'd a proper

Thickneſs between their Crowns and the Paving of the Bridge.

This Alteration, I muſt own, would occaſion a greater Thruſt from the Crowns to the Abutments below, but as the Upright of one of his Piers taken from the Springing of his Middle Arch, conſider'd as one Foot thick, contains above 112 Ton Weight, it would be more than ſufficient to counter-ballance the Weight or Thruſt from the Crown, and be able to ſupport any of his Arches independent of each other, for carrying the Building a convenient Height above the Arches, not only loads the Arch, but the Pier alſo, which muſt be conſider'd as an Abutment to the Weight laid on the Crown, for it is not the Extent of an Abutment, but the Solidity that ought to be conſider'd as moſt capable to reſiſt any Force, or Power, that wants to remove it; therefore as the Abutment increaſes in Proportion to the Weight laid on the Crown, I cannot ſee how an Arch can be well over-loaded if their Abutments are good, and there is no more Weight laid on than the Foundation will bear, which, I muſt own, ought to be conſider'd.

But to ſtrengthen this Argument, I think, the Arches of *London Bridge* may be conſider'd as a very good Precedent to ſhew what Weight Arches will bear, for as the Diſtance between the Crowns of thoſe Arches and the Paving of that Bridge, by far exceeds any that is deſign'd for the new One, and if the Materials are the ſame the Weight muſt exceed in the ſame Proportion, and add to that the Load of Houſes, and then conſider the Length of Time that thoſe Arches have ſupported that Weight. I ſay, if theſe Things are conſider'd, I cannot ſee any Occaſion for our modern Deſigners to be ſo fearful of overloading theſe Arches, and omitting a Weight or Thickneſs where it is moſt wanted.

This I ſhall endeavour to make appear by the following Compariſon, which, notwithſtanding it being a low one, may chance to be more convincing than any Argument I can make uſe of, that is, (if ſmall Things may be compar'd to great) I don't know any Thing that appears ſo much like a Bridge ſupported by Arches, as a long Board cut in Pidgeon-holes. Now I think it cannot be deny'd by any Man that hath any Notion of Building, that the nearer thoſe Holes or little Arches are cut to the upper Edge of the Board, the weaker ſuch a Board will be, and conſequently the more unfit to ſupport any Weight that ſhould be roll'd over it. Therefore, if this Compariſon be juſt, it muſt appear very plain that the Strength of all Bridges (in reſpect to heavy Burdens paſſing over them) muſt depend on the Thickneſs or Strength of Materials that are work'd over their Crowns.

For if that thickneſs of Materials be conſidered as a Quantity of Matter at reſt, that is to receive a leſſer Quantity in Motion, it muſt certainly be neceſſary to ſo proportion thoſe Quantities of Matter, that the Leſſer will give no Diſturbance to the Greater, for it cannot be deny'd but that a leſſer Quantity of Matter in Motion may diſturb a greater Quantity that is at reſt, therefore it's very reaſonable to think that heavy Burdens paſſing over any Bridge, whoſe Quantity of Matter or Materials on the Crown is not ſufficient to reſiſt the Motion of the Burden paſſing over, muſt in Time ſuffer Damage; for its well known that ſo ſmall a Weight or Quantity of Matter as a Coach and Pair, by moving with a ſwift Velocity (over pav'd Stones) doth very often affect the Houſes of ſeveral Streets in *London*, by cauſing a very ſenſible Tremulation in the Buildings thereof.

I ſay, this may chance to be of an ill Conſequence to any publick Bridge ſupported by Arches that hath not a ſufficient Thickneſs of Materials laid on their Crowns that is able to reſiſt the Jolts and Surges of any Burden that may chance to paſs over it without ſuffering any Diſturbance thereby, and it is from this Conſideration that I have before obſerv'd (in *p.* 54) that the Weight of Houſes erected on *London*-Bridge hath very much contributed to its Preſervation, by preventing thoſe frequent Strokes and Shakings that it muſt otherwiſe have felt, if ſuch a Weight had not been laid thereon, and if Weight hath been a Benefit to the Old Bridge it muſt conſequently have the ſame Effect on a New One.

As to laying the Foundation of the Piers in Coffers, or Floats, I have before (in *p.* 60.) ſhew'd my Diſlike, and have there given a Method that ſeem'd to me more practicable, but ſince my reading two Pamphlets, and finding that ſeveral ingenious Men have thought it worth their Conſideration, it hath induced me to think more cloſely on the Subject, therefore I ſhall venture to propoſe another which will be leſs expenſive, and to a better Effect.

In my former Method, I propos'd Piles and Planks to be dovetail'd, grov'd together, and ſharpen'd at the lower Ends and ſhod with Iron, in order to drive into the Foundation round the Plan of the Piers to keep out the Water until the Foundation was laid, and carry'd on above High Water Mark, which I believe would have anſwer'd the End propos'd, but as conſidering the

Accuracy of the Workmanſhip that will be requir'd in ſuch a Performance, and the Time it will take up to make ſo many Grooves in a Dovetail Form, and alſo the Difficulty that will attend the getting of them aſunder in order to make them drive again, hath occaſion'd my altering of my firſt Deſign to the Method following.

This is inſtead of the before-mention'd Planks and Piles that was propos'd to be dovetail'd together and drove ſeperately into the Foundation, I here propoſe they ſhould be made into Flood-gates which will have no Occaſion to be grov'd but only join'd together and made in two Thickneſſes after the common Manner of making ſuch Gates, as is ſhew'd in *fig.* 63. only the lower End of the long Planks muſt be ſharpen'd, and the Sides or Edges ſo ſharpen'd ſhould be bevel'd off in ſuch a Manner as to leave an Edge in the Middle that when they are well ſhod with Iron they may the better cut their Way into the Foundation, the Piles muſt be grov'd to receive the Gates, and to be done in ſuch a Form as will circumſcribe the Plan of the Pier, obſerving to leave Room for Men to Work.

The Diſtance of the Piles to be about four Feet which will terminate the Width of the Gates which are to be drove into the Foundation between every two Piles, which for the better Conveniency of driving muſt have a Capſill tennanted on to the upper End to raiſe the Weight whoſe Thickneſs ought to be the ſame as the Capſill and the Shape like that I have given at the Top of the Gate, and to ſlide in Groves to give it a proper Direction, after the common Method of driving of Piles.

Such a Range of Gates and Piles (as I have obſerv'd before) by Reaſon of their great Length will want to be ſtrengthen'd to make them able to reſiſt the external Preſſure of Water which (undoubtedly) will be very great. Therefore in this Caſe, as in the former, there muſt be other Piles drove in (without-ſide the Range) 4 or 5 Foot diſtance from every ſecond or third Pile belonging to the whole Range, and brac'd thereto Diagonal Ways as near to the Bottom as the loweſt Water will admit, which will add a great deal of Strength to the whole Range and prevent the Weight of Water from puſhing it down.

Such a Method if the Materials are good the Work well perform'd and carefully executed is very likely to keep out the external Water, when the internal is all laved or pump'd out, for I cannot conceive that the Leakes will let in more Water than a Chain Pump or two will be able to diſcharge, by Reaſon all thoſe Leaks that will happen above Low Water Mark may be ſtop'd from without, and thoſe that happen below may be ſtopp'd from within as the internal Water ſinks, therefore, I cannot ſee any Room to doubt of the Foundation being laid dry, or at leaſt dry enough for Workmen to lay the Foundation of any of the Piers, and to work with the ſame Safety, as if the whole Current of the River was turn'd into ſome other Channel.

I ſay, this Method is the more likely to anſwer the End propos'd, by Reaſon it is nearly the ſame that hath been ſo long practic'd by Millwrights to dam up large Heads of Water for the Uſe of Mills in Rivers which they generally turn into ſome other Channel, and by that Means can come at the Bottom of the River to lay in a Ground Sill for the Gates to ſhut, which are commonly made to ſhut ſo cloſe as to let no Water paſs by when the Gates are ſhut.

But to compenſate for ſuch a Sill which cannot be laid with any Certainty in the River *Thames*, I have propos'd the Gates to be made in ſuch a Manner as will drive into the Bottom of the River, which appears to me to be a better Security to prevent their Blowing at Bottom, than any Ground Sill be it never ſo well bedded to the River's Bottom, and as the ſharpen'd

Ends of ſuch a Gate taken together will contain but a little more Solidity than the ſharpen'd End of a ſingle Pile, that is one Foot Square, it's very likely to want but a little more Power to drive it in, and conſidering the Gate will be in Parts, it may, perhaps, require leſs, but this I refer to Experiment.

As to the Nature of the Foundation or Bottom of the River where the Bridge is to croſs over, I muſt own, that I am unacquainted therewith, but it hath been obſerv'd that it conſiſts of two Stratums, the one Clay and the other Gravel; and in order to ſuit both, they have propos'd two Sorts of Coffers, or Floats, for the laying the Foundations of the Piers, but the Method that muſt be made uſe of to make the Materials of one ſerve again for another is what is conceal'd, but whether they are conceal'd for the Reaſons there given, or from ſome other Motives, I will not pretend to determine.

But however that be, I believe it will appear from the Nature and Form of thoſe Materials I have propos'd for that Purpoſe, that after they have perform'd their Duty to the firſt Piers they will admit of being drawn out and drove in again (to the ſame Effect) for the Second, and if there is but one Pier to be carried on at the ſame Time it is not impoſſible for one Set of

Gates and Piles to ſerve for the whole Bridge; for be the Stratums at the Bottom, either Clay or Gravel, if the Gates and Piles be well ſhod with Iron, there is no Fear, but they will make their Way into the Foundation.

And if the Bottom of the River conſiſts of two ſuch Stratums as Clay and Gravel, it is reaſonable to think that the Gravel is the lowermoſt, and muſt appear in the Channel, and if ſo, according the River's Section, the Stratum of Clay cannot be of any great Thickneſs, but may be clear'd off from the Gravel at a leſs Expence, and to a better Effect, than to drive in a great Number of Piles, and after that to be at the Expence of Oak Planks, in order to gain a Foundation, when perhaps the Sinking of two or three Foot may ſave that Expence, and have a better Foundation, than can be expected from any Timber whatſoever, for unleſs it can be demonſtrated, that Timber is as durable as Stone, (I think) it ought to be rejected as unfit to ſupport any Stone Building, eſpecially one that is deſign'd for the Uſe of Ages to come.

I am not inſenſible, that Oak-Timber will laſt (if buried in Earth or Water) many Years longer than if it was expoſ'd to the different Mediums of our Atmoſphere, which is continually ſhrinking and ſwelling all ſuch porous Bodies, that in Time deſtroys the Coheſion of their Parts, and occaſions them to molder away and become reduc'd into their firſt Principles. But, notwithſtanding this Difference, it cannot be denied, but that Stone is more durable than Timber; therefore it would be very improper to put the Weak to ſupport the Strong, and for thoſe who have a Mind to ſee the Effect of ſuch a Foundation may go no farther than the New Church at *Weſtminſter*, where they may ſoon be convinc'd by the ſeveral Fractures that are viſible in that Building, that Piles and Planks (which is Part of that Foundation) is an improper Baſement to ſupport a Stone Bridge over the River *Thames*.

But to give the greater Credit to ſuch a Propoſal, the Author hath endeavour'd to perſuade us, that *London Bridge* hath no other: But this by way of Suppoſition, and I do not ſee why any Body elſe may not (with as good Reaſon on their Side) ſuppoſe the contrary, for if the great Weight of that Bridge be conſider'd, and the many Years it hath been ſupported by the Foundation, there is but little Reaſon to believe it to conſiſt of Piles and Planks, but rather of ſome good hard Stone well bedded on a Stratum of firm Gravel that hath been able to reſiſt ſo great a Preſſure for ſo many Years.

Neither can I ſee any good Reaſon for Mr. *James* to ſuſpect the River's Bottom of being inſecure, and not able to ſupport a Stone Bridge; for it is well known, that where the

Foundation of Roads are become inſecure, and have a proper Deſcent to carry off a Current of Water when let in upon them. I ſay, ſuch Roads (if they are not a Clay) will become more ſecure, for Water being let in upon them, and ſeldom want any other Repair.

Therefore it is reaſonable to believe, that the Bottom of the River *Thames* cannot be the worſe for ſo large a Current of Water paſſing over it, but the better, and if the ſame Stratums are to be met with, at the *Wooll Staple*, or *New Palace Yard*, or at the *Horſe Ferry*, as are at *London-Bridge*, there is no Room to doubt of their ſupporting ſo great a Weight.

I might have enlarg'd my Obſervations on what others have publiſh'd relating to the Bridge. But as I have already carried this Performance to a greater Length than I firſt deſign'd it, and the Time ſeems to be ſo near at Hand that the Bridge muſt be begun; I ſhall forbear to make any further Remarks thereon; but only obſerve, by way of Caution to thoſe it may concern that good Nature hath always been eſteem'd a very amiable Quality in an Author, and where that is wanting the Force of his Arguments are very often loſt, for when a Man is angry his Reaſon is generally ſuſpended, and he ſeeth Things through a falſe Medium, and what he hath to ſay againſt an Adverſary at ſuch a Time ought not ſo much to be rely'd on, as if it had been the Reſult of a cool and deliberate Conſideration; therefore, I think, there ought to be ſome Allowance in Caſes of this Nature, and before we cenſure (too raſhly) the Miſtakes of others, we ought to conſider thoſe of our own.

I ſay, ſuch a Reflection if it did not make us over-look the Miſtakes of others, it ought to at leaſt to direct one of our Eyes towards their Merit; for it is but reaſonable, for every Man that pretends to have any Merit of his own, to have ſome Regard to the Merit of others, and if a Man is not inſolently ignorant he ought to merit our Compaſſion rather than Contempt; for my own Part I am ſenſible of this Imperfection in our Nature, and ſhould be very unwilling to affirm any Thing as poſitive that will not bear Demonſtration, eſpecially any Thing of ſo precarious a Nature as the laying a Foundation for a Bridge over the River *Thames*, which nothing but Experiment can juſtify to be right, for notwithſtanding what I have propos'd, for that Undertaking, may appear to me to be practicable; it may appear otherwiſe to thoſe of a more diſcerning Judgment, who (very likely) may propoſe better of their own, which if they do, it will give me no Manner of Concern, becauſe I have no Expectation of any Fee or Reward whatſoever; therefore I ſhall have more willingly offered what I have ſaid (in reſpect to the Bridge) to the Peruſal of the Publick, hoping they will be ſo good-natured as to excuſe the Want of fine Language, or ſome other Defects that may (very likely) be found in this Performance, which I ſhall now conclude.

FINIS.

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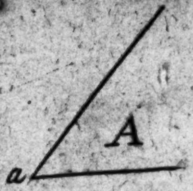

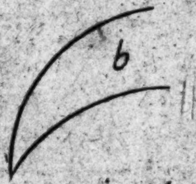

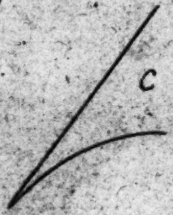

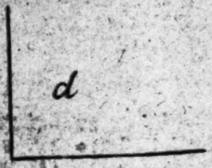

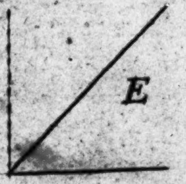

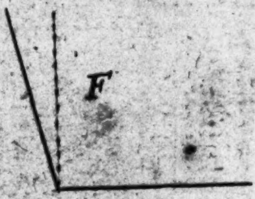

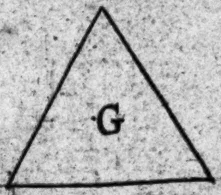

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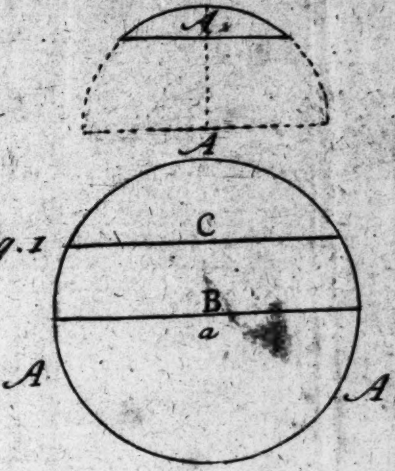

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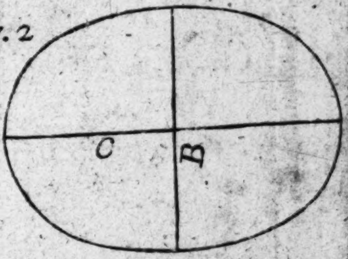

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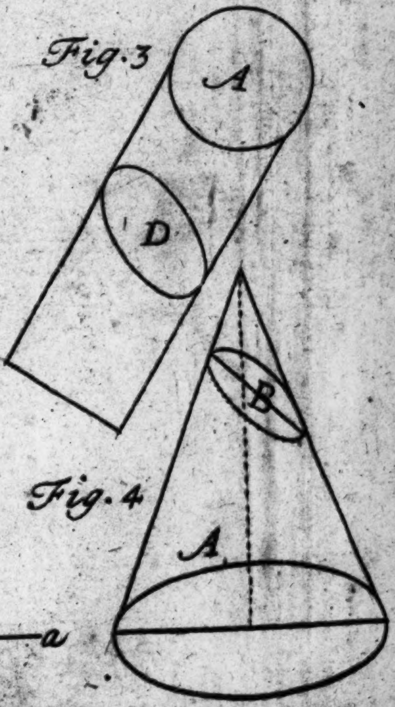

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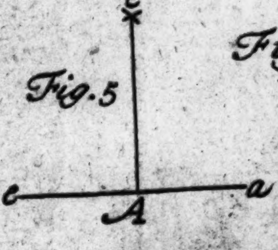

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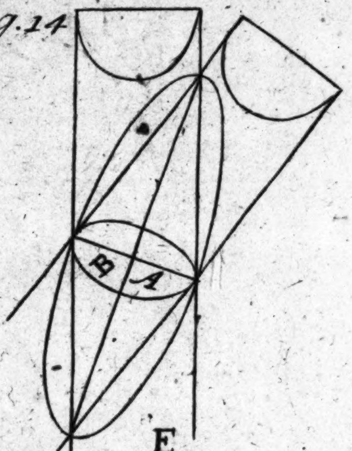

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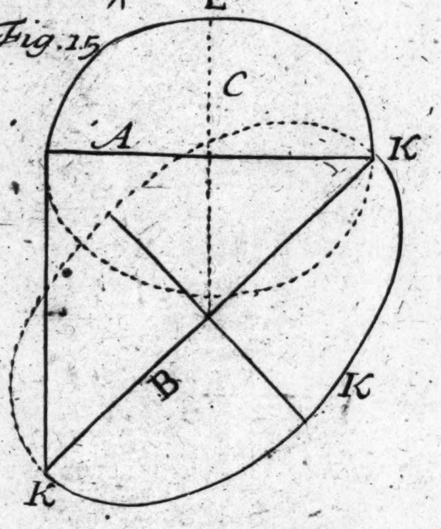

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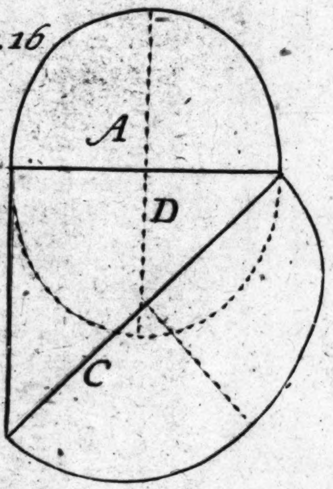

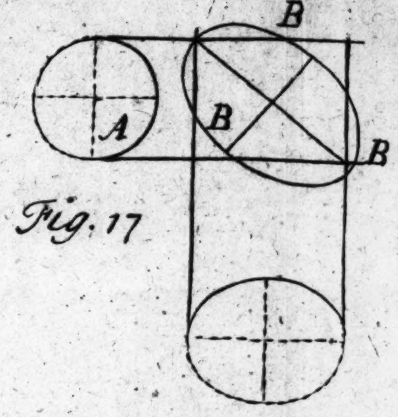

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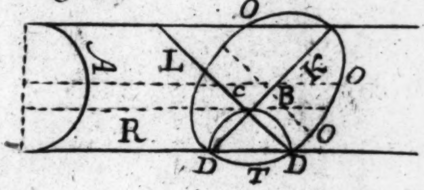

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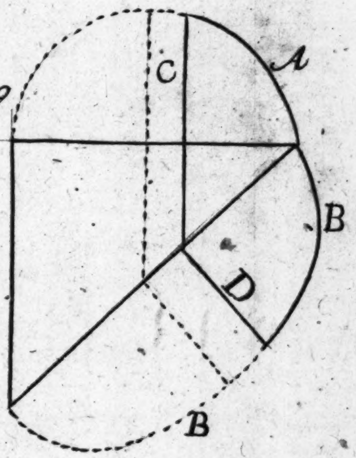

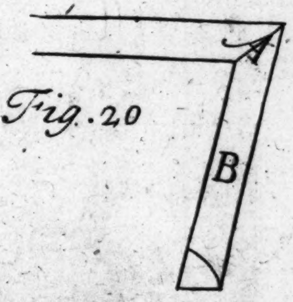

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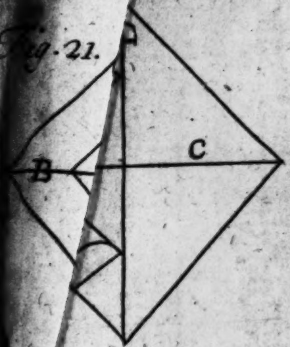

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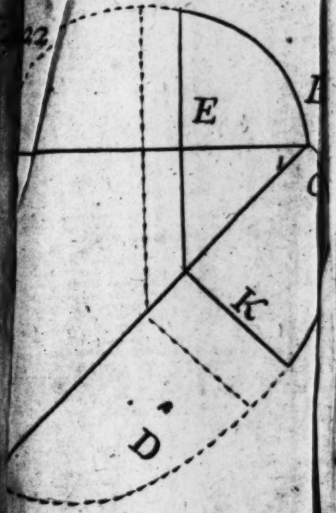

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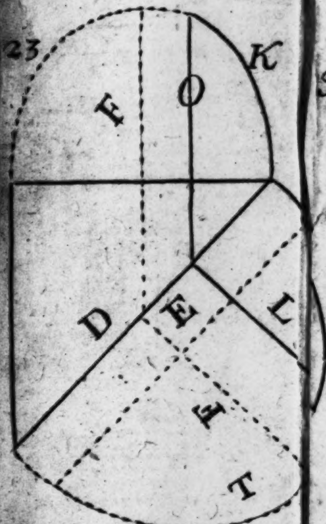

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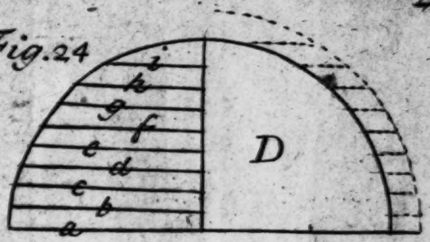

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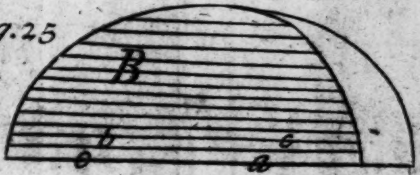

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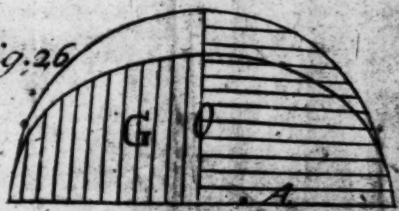

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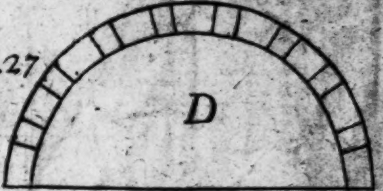

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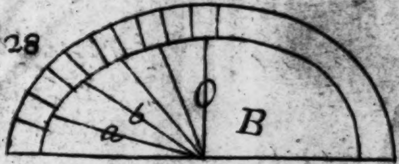

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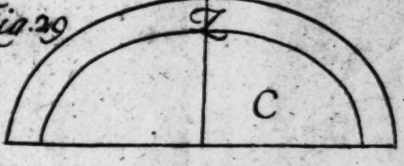

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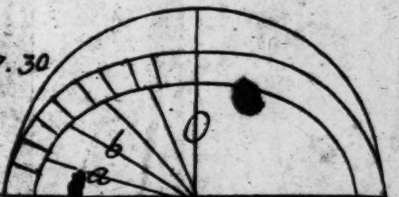

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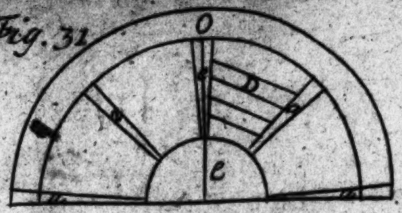
Fig. 31



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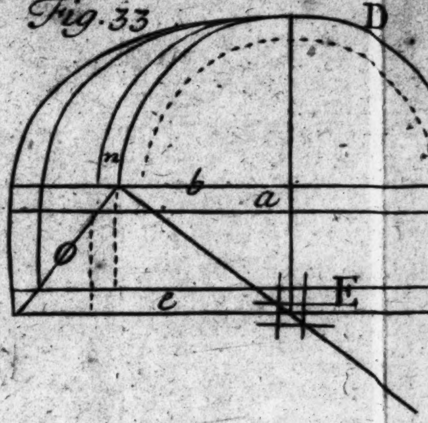

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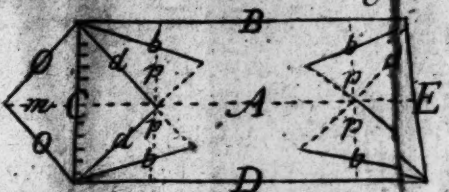

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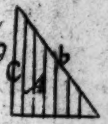

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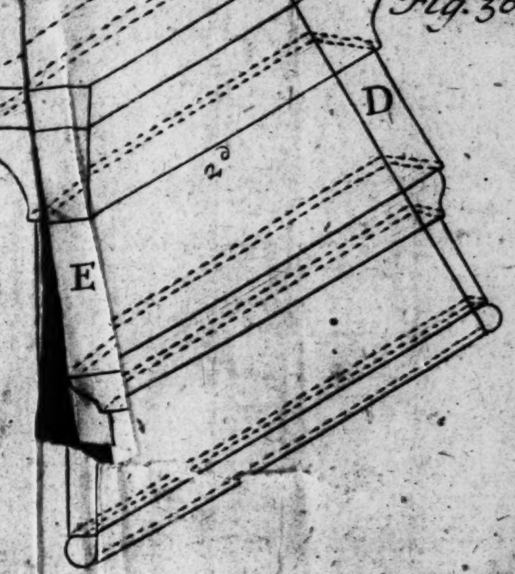

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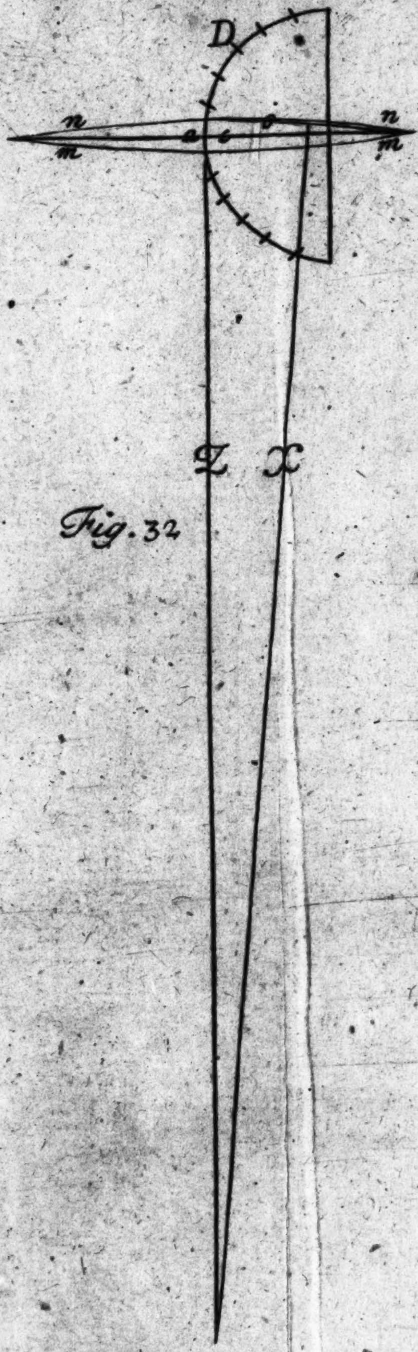

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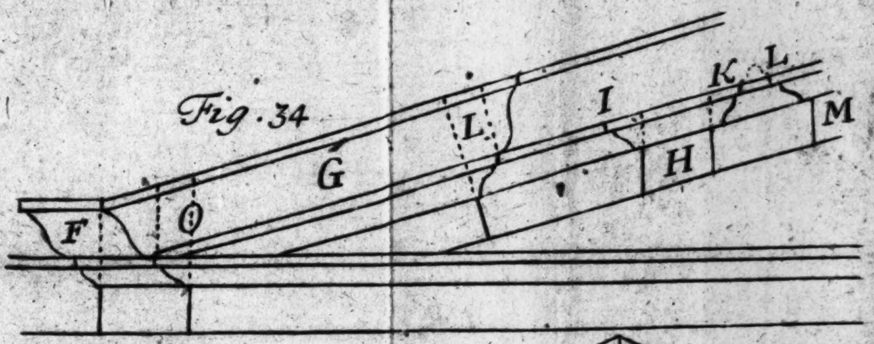

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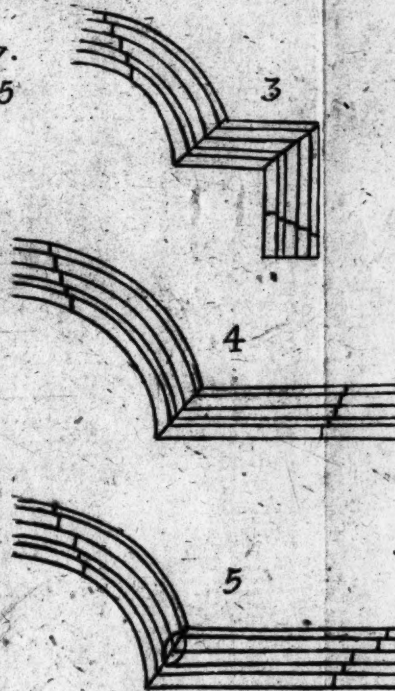

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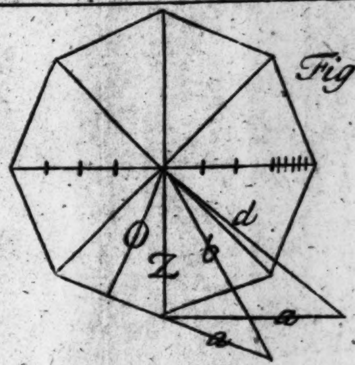

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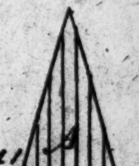

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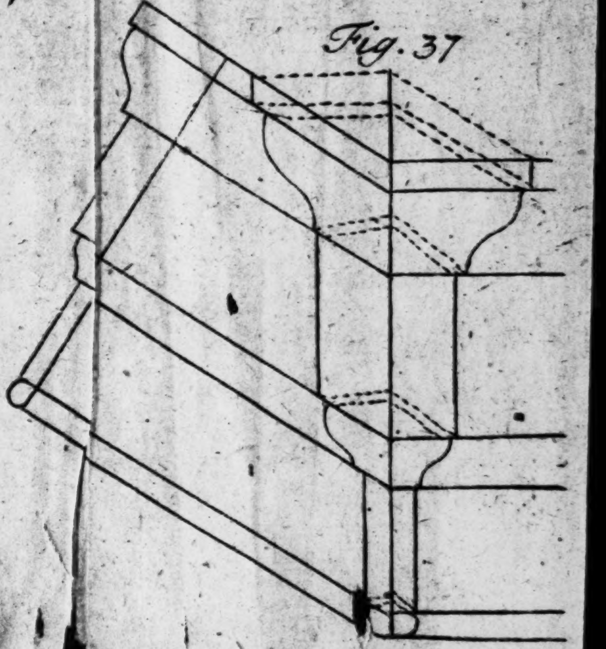

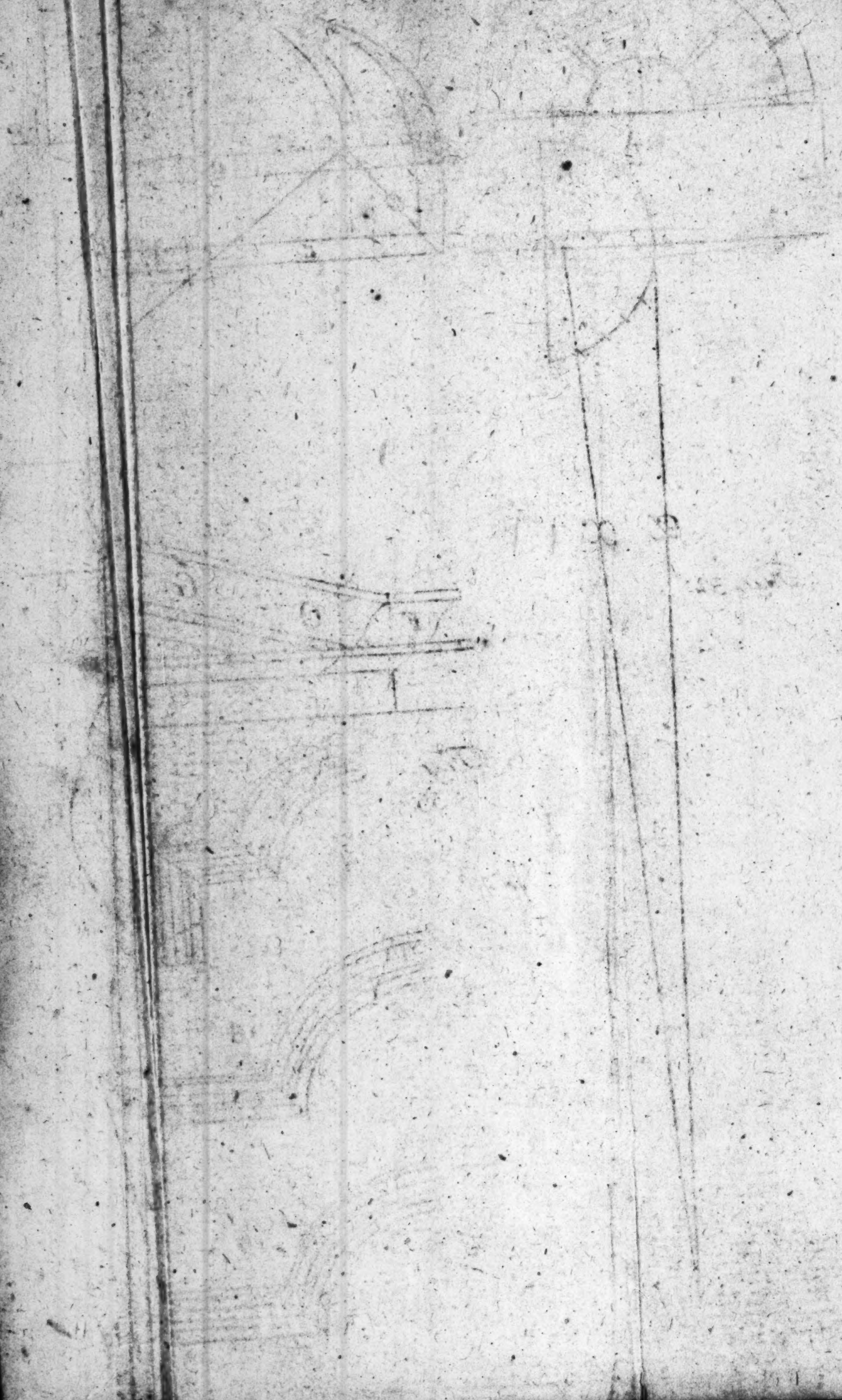

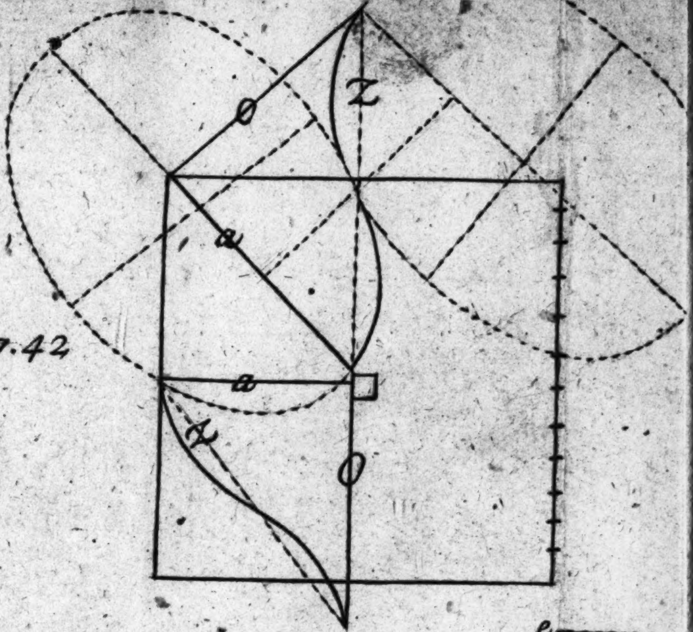

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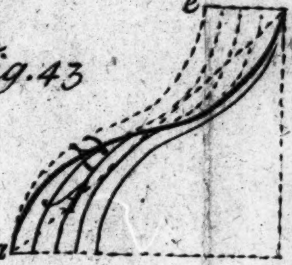

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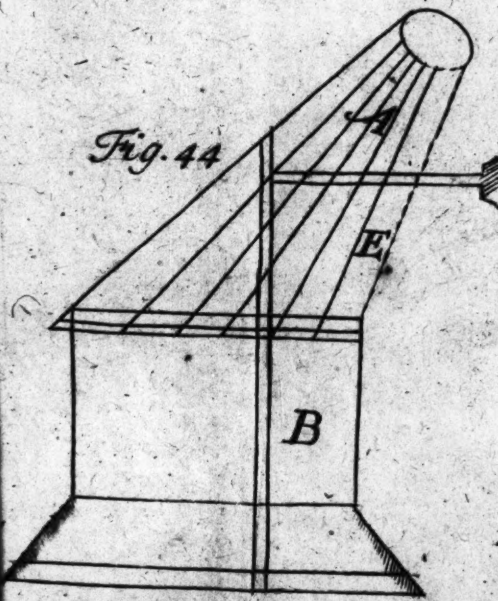

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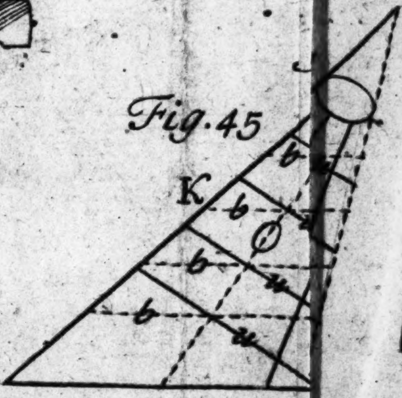

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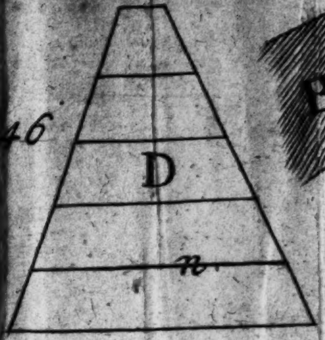

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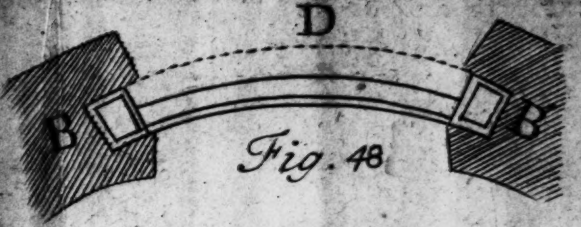

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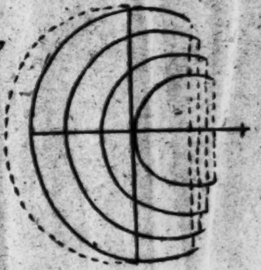

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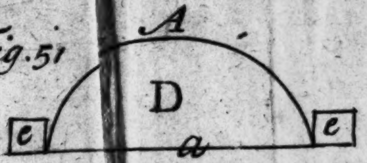

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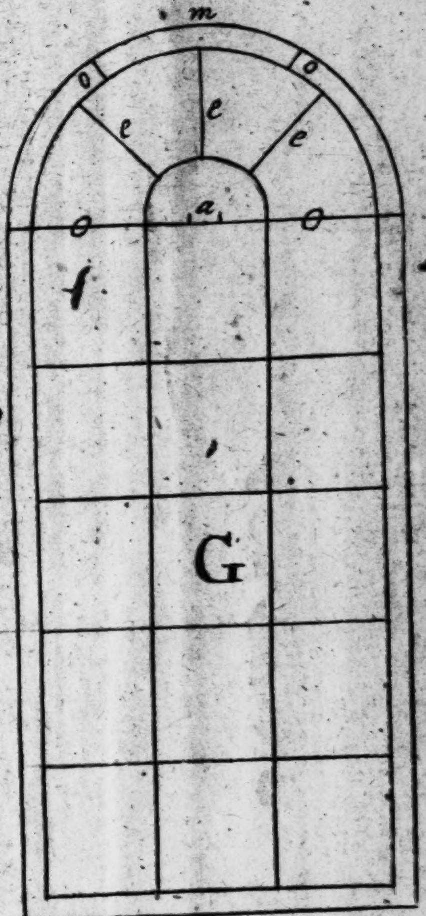

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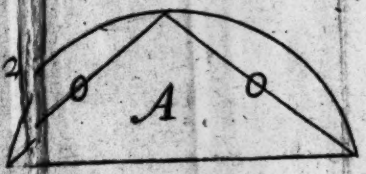

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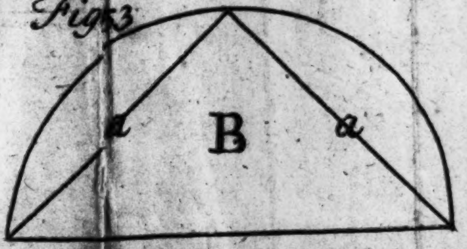

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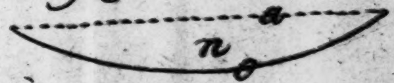

Fig. 50

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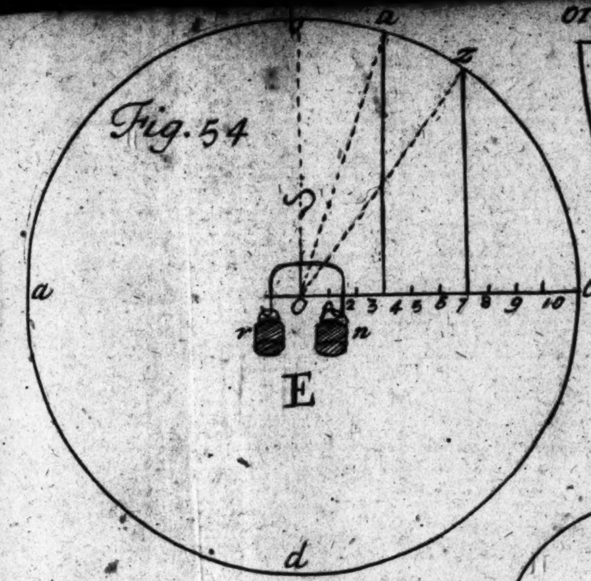

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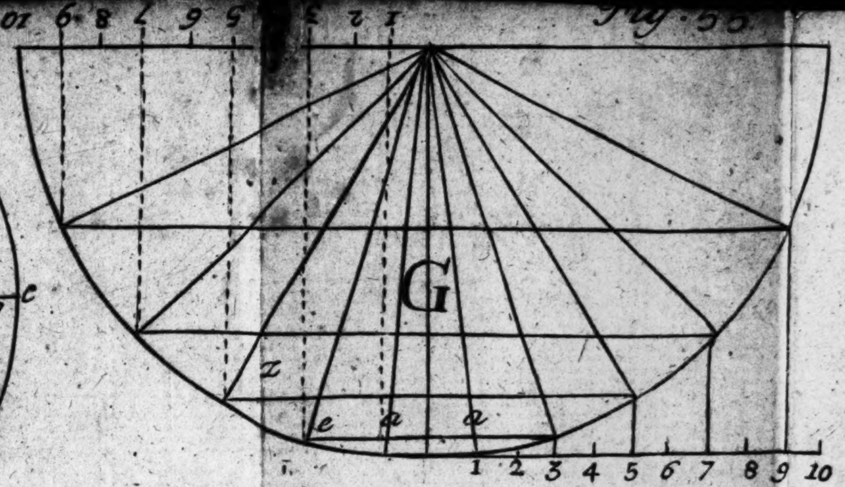

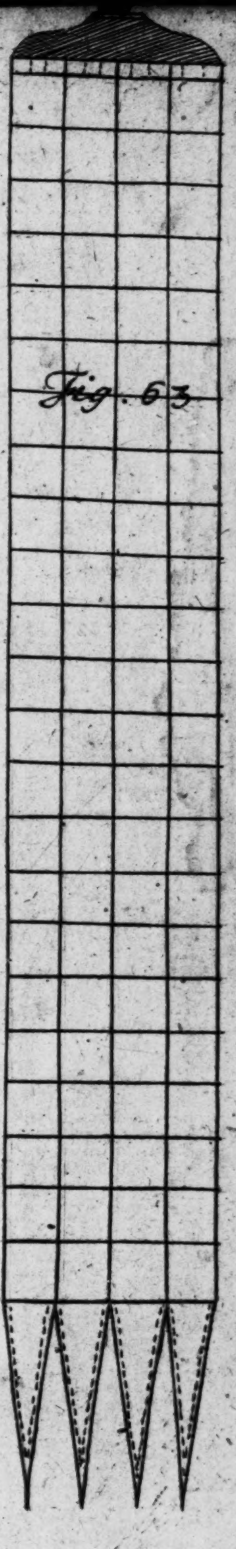

Fig. 63

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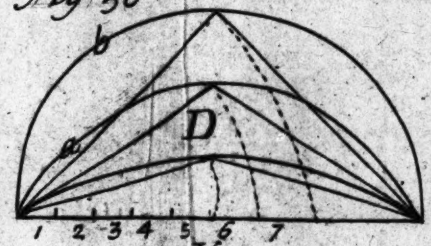

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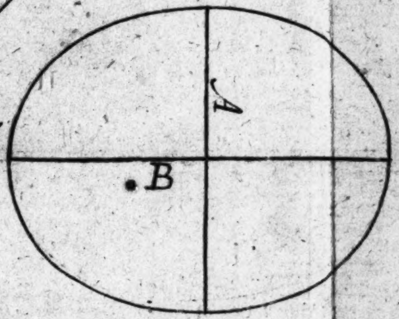

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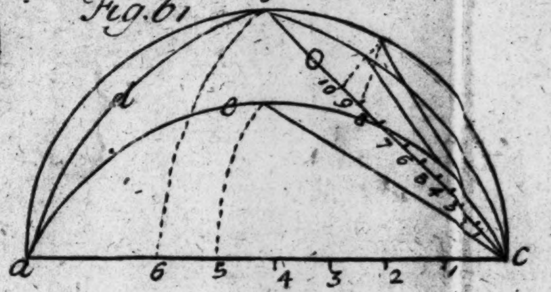


Fig. 58

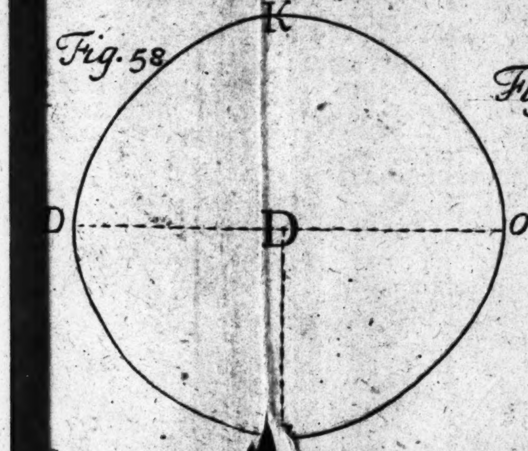


Fig. 60

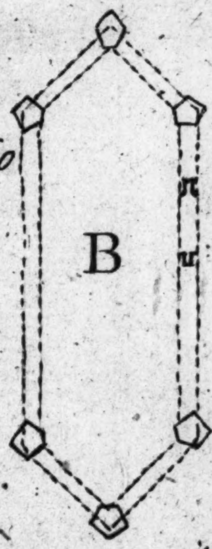
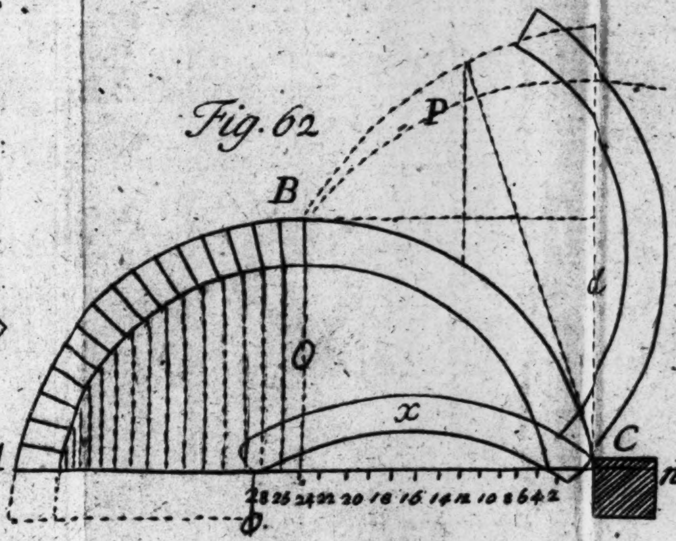


Fig. 62



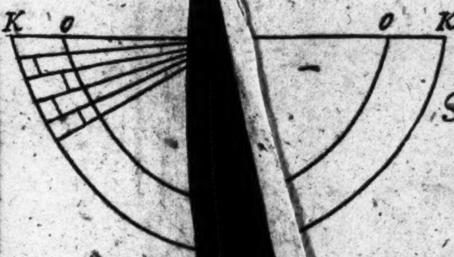


Fig. 59